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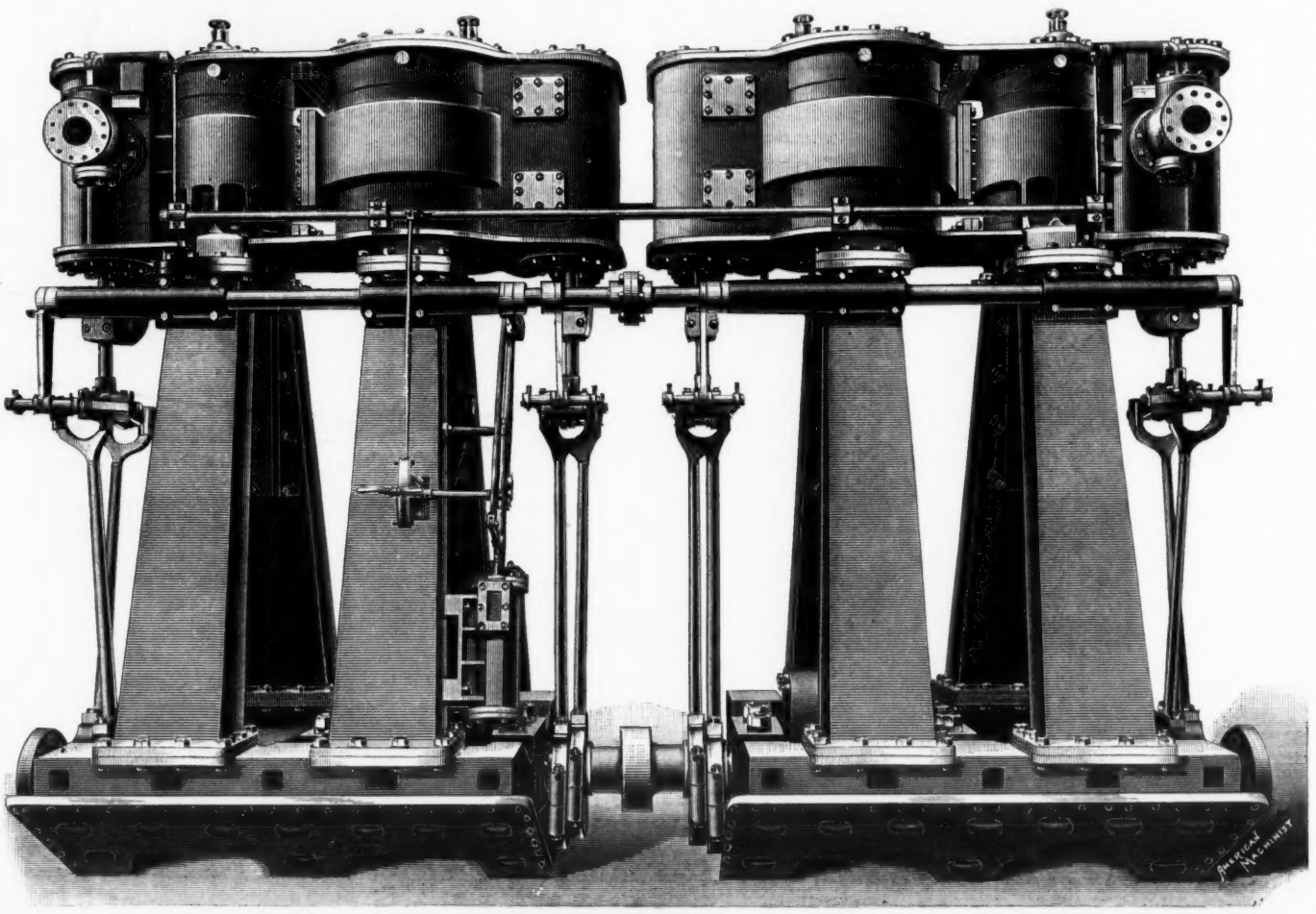
New Ferryboats for the Hoboken Ferry.

The ferryboats of the new type, of which the "Bergen" was the forerunner, built for and first introduced in the New York harbor by the Hoboken Land and Improvement Company, are growing in favor, and have been adopted by other ferry companies. These boats have, instead of the usual side wheels, a propeller at each end, keyed to a shaft running throughout the whole length of the boat. Their adoption by other companies seems to indicate that these boats are beyond an experimental stage, and they will probably take the place of the side-wheelers, in the near future.

The very satisfactory performance of the "Bergen," during a service of over two years, encouraged her projectors to build two more of the same type, the "Bremen" and the "Hamburg," which are now nearing completion in the company's docks at Hoboken. They are larger than the "Bergen," whose dimensions, with an illustration of her engines, were given in our issue of November 24, 1888. The "Bremen" and the "Hamburg" are exact duplicates of each other; the former is in a more advanced stage of construction, and will soon take her place in the line of service.



COMPOUND ENGINES.

The hulls of the two boats were built by T. S. Marvel & Co., Newburgh, N. Y. They are built of steel. The length of each over all is 222 feet; length on water line, 218 feet 6 inches; breadth over all, 62 feet; breadth on water line, 35 feet; draught, light, 10 feet 6 inches; draught, loaded, about 11 feet; depth of hold, 17 feet. These boats are double-decked. The upper saloon is 97 feet long by 36 feet wide, and 10 feet high. It has a promenade hood extending all around it, butting against the pilot-houses, giving the whole a pleasing appearance. The lower saloons are 157 feet long, with an average width of 15 feet; height, 13 feet. A double-stairway leads from each lower saloon to the upper one. The total seating capacity in each boat will accommodate about 450 persons.

Each boat has two compound engines, as shown in the accompanying illustrations on this page and page 2. They were built by W. & A. Fletcher Company, North River Iron Works, Hoboken, N. J.

High-pressure cylinders are 20 inches diameter; low-pressure cylinders, 36 inches diameter; stroke, 28 inches. Each boat is provided with an independent air and circulating pumping engine of the Blake system, with compound steam cylinders similar in general design to those furnished for the U. S. Battle ship "Maine." They are of the following dimensions: High-pressure cylinder, 7 inches diameter; low-pressure cylinder, 14 inches diameter; stroke, 16 inches. These work two single-acting vertical air-pumps 17½ inches diameter, and 14 inches stroke. One double-acting horizontal circulating water cylinder, 17 inches diameter, 16 inches stroke. The whole system is illustrated on page 2; Fig. 1 being an elevation, and Fig. 2 a plan, but drawn on a larger scale than the former. The seats for the salt-water valves in the circulating pump are formed in solid composition plates, instead of seats driven into cast-iron. The piston and piston rods are of composition, and the air and water cylinders are lined with composition. The extra amount of valve area permits the pumps to be run at a high rate of speed.

The initial steam pressure in the main engines will be 125 pounds, furnished from two horizontal boilers, 9 feet 1 inch in diameter, and 21 feet long. Each has two corrugated furnaces, 44 inches diameter. Total grate surface, 100 square feet. The boilers were tested to 250 pounds hydrostatic pressure.

The diameter of the crank-shaft is 9½ inches. The cranks in each engine are set opposite to each other, and when the engines are coupled, the center line of cranks in one engine will be perpendicular to that of the other one, so that the cranks practically stand at 90 degrees apart. With this arrangement smoothness of running is assured, and the engines can be started from any position.

Every care has been taken to promote the comfort and safety of the passengers, and these boats will add much to the popularity and reputation of the Hoboken Ferry.

For the dimensions, photographs and blue-prints from which the illustrations have been made, we are indebted to W. & A. Fletcher Company, Blake Manufacturing Company, and to Capt. C. W. Woolsey, superintendent of the ferry.

We are informed that the suit over the Ball engine has been decided in favor of the Ball & Wood Company, of New York, by the United States Circuit Court.

Cupola Fluxing.

BY CHARLES SMITH.

In building a foundry, the size cupola to put in that will meet all possible requirements has often been a subject of serious thought to the foundryman. There are two sizes capable of producing such satisfactory results, if properly handled, that they commend themselves at once. The 36 inch cupola —inside measurement—is easily good for from twenty to twenty-five tons, and the 48-inch cupola nearly double that amount.

This yield from the above size furnaces may seem surprising to any one not handling large quantities of metal, but all statements herein contained are taken from actual *daily* experience, and the statements made, not in any sense to air fancied wisdom, but as an earnest mite, contributed humbly to assist in part in leading to a better understanding of our cupolas. The 36 inch cupola should melt from four to five tons of metal each hour, and the 48-inch should melt from eight to ten tons per hour.

If the 36-inch cupola were to be run without slagging it would probably stagger when from ten to twelve tons were run through—the accumulated dirt, ash and dross from fuel and metal having by that time gathered to such an extent around the tuyere holes as to prevent the free access of the blast, consequently slow melting and dull iron follows. At twenty tons the 48-inch cupola would show clear signs of weakening, if the dirt was not removed from the bottom of the furnace; therefore, to make our cupolas do heavy duty, we resort to slagging or fluxing. To do this, either limestone, marble chips, fluor spar or oyster shells are generally used. The shells commend themselves, as they can be secured cheaply, and do the work in a splendid manner. But there is another duty performed by the flux, which should not be lost sight of.

As soon as the flux commences to melt it forms a complete web across the inner lining of the cupola, below the tuyeres; when this slag gathers to such a degree that it is necessary to remove it, the furnance is not tapped for iron until the gathering body of molten metal, rising high on the inside of the cupola, forces the slag with which it is crested high as the slag hole, thus allowing the dross and dirt to run off with the flux; when the molten iron makes its appearance at the slag hole, and not until then, the furnace is tapped, and the metal run off into ladles.

Now, as all melting is done above the tuyeres, and the slag web is below them, all molten metal released from its compact form by the action of the heat has to pass through the slag web, and is filtered, so to speak, before reaching the furnace bottom. The proof of this to me has been that in running a 36-inch cupola without slagging, on heats of from seven to ten tons, pouring basins, storage gates and horned gates had to be resorted to, to insure clean work, while in running heats of from fifteen to twenty-five tons in the same size cupola, where slagging was resorted to, no trouble was experienced

in getting clean work, though only ordinary sprues and gates were used, and pouring basins were built only on heavy crane ladle pieces.

It must not be claimed that slagging will nsure clean work, for there are other things which enter into the production of clean castings, but it is mentioned as one of the safeguards, tending towards the production of good work; but with proper iron, a cupola well slagged, and a mold that will stand the metal without cutting, it is not difficult to secure clean, sound castings.

The amount of flux—oyster shells—to be used on a charge, should be about fifty pounds of shells to a ton of metal. The object of the shells being to make the slag run quite fluidly during the heat, no cast-iron rule should govern the amount of shells used on a charge, until the furnace has been gauged as to just the proper amount necessary to bring about the action sought, for there are wind conditions, and other matters, hardly alike on any two cupolas, that must be catered to before a rule to govern the amount of flux to put on each charge can be determined. Have enough to make the slag run from the slag hole readily, without trying to dig it out with a crowbar.

Some claim that flux, if freely used, will harden the metal. I have been watching a firm for some months past, that daily melt upwards of two hundred tons of metal, and use flux freely, yet trouble from hard iron is a rare occurrence. The only complaint heard about flux is that it is severe on the fire-brick. Here is a form for charging a 36-inch cupola to melt from fifteen to twenty-five tons of metal at an average rate of from four to five tons per hour.

Bed	800 lbs. coke.
First charge iron	3,000 lbs.
First charge oyster shells	60 lbs.
Second charge coke	175 lbs.
Second charge iron	2,000 lbs.
Second charge oyster shells	50 lbs.

Continue second charge form through entire heat.

For a 48-inch cupola, melting from eight to ten tons per hour:

Coke bed	2,000 lbs.
First charge iron	4,000 lbs.
First charge oyster shells	75 lbs.
Second charge coke	275 lbs.
Second charge iron	4,000 lbs.
Oyster shells	75 lbs.

Continue second charge form through entire heat.

Compound Engines.

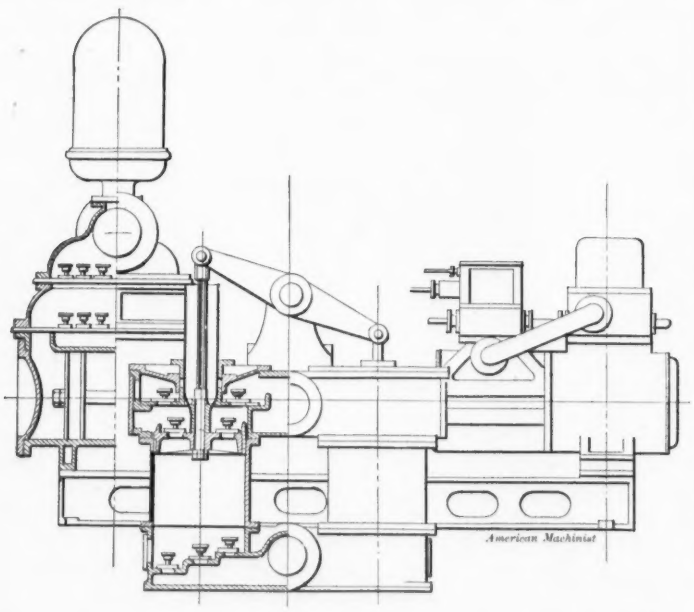
BY JAMES TRIBE.

FOURTH PAPER.

TWO-CYLINDER COMPOUND ENGINES, AND HOW TO DETERMINE THE RATIO OF CYLINDER AREAS UNDER DIFFERENT CONDITIONS

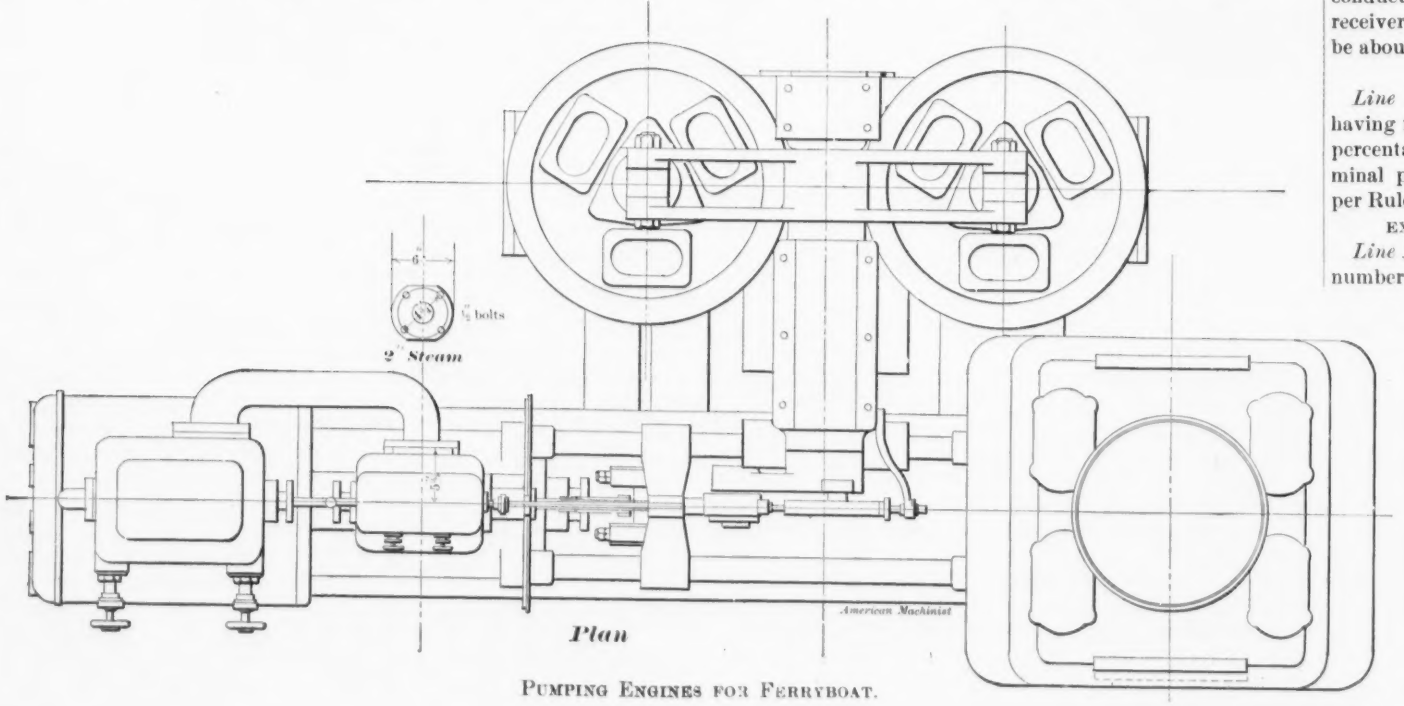
Probably the most common type of compound engine now in use for land service is the two-cylinder condensing, designed for a steam pressure of 120 pounds by gauge. But notwithstanding the fact that this pressure is so generally adopted, and is no doubt the most desirable for a two cylinder compound engine, yet in many steam plants other conditions render it necessary to carry higher or lower pressures to suit the particular cases.

It frequently occurs that the old cylinders and valve gears of a pair of engines are removed and replaced by new ones, using the old beds, connecting rods, crossheads, etc., all of which were originally intended to sustain only a limited initial steam pressure of say 85 pounds or so. Furthermore, the boiler may not be considered safe to carry more than this pressure, and the conclusion may be to design a compound of the best proportions that the conditions will allow. On the other hand, for some reason or other a two cylinder compound may be required to take steam from boilers carrying 150 pounds or 155 pounds pressure. Now the proportions of these two extreme cases will be very different, as will be seen below.

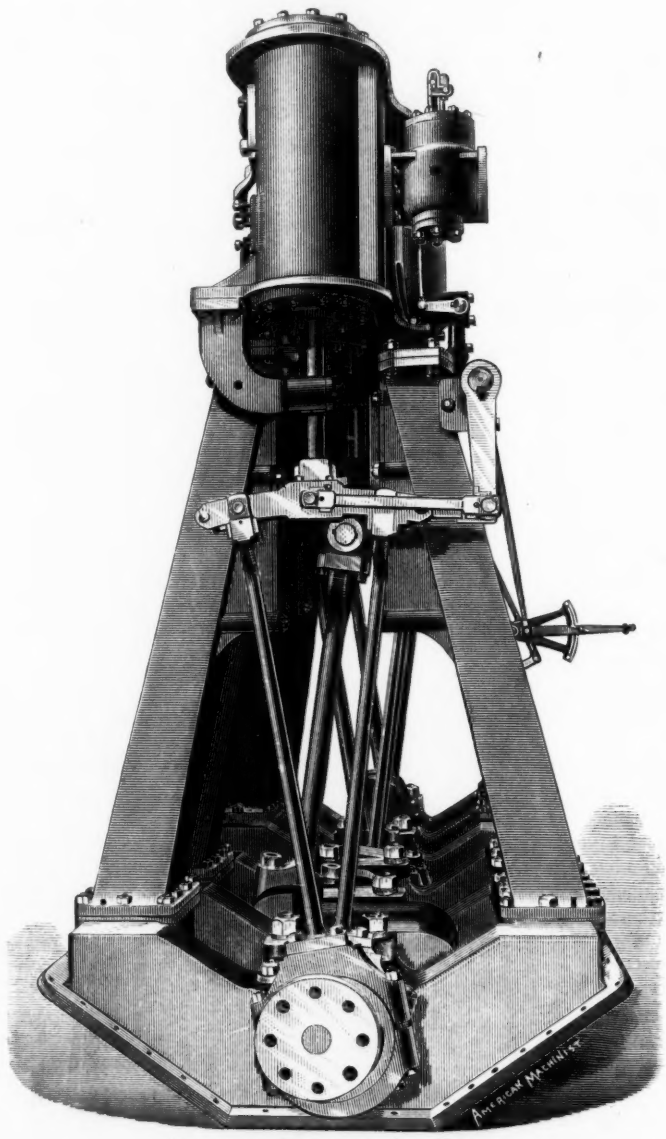


The proportions of the parts subject to strain, the ratio of cylinder areas, and the positions of cut-off, all depend entirely upon the initial steam pressure, and can be so calculated that the best possible result under these fixed conditions may be readily obtained. The horse-power of a compound engine has nothing whatever to do with the ratio of the cylinder areas, nor even with the position of cut-off, except so far as to accommodate a temporary change of load, but should be provided for solely by the extent of the effective areas, and the piston speed.

On the above considerations, all the most important data, such as the mean effective pressures, positions of cut-off, number of expansions, etc., in each cylinder, each of which is dependent upon the boiler pressure, can be determined and tabulated for comparison and ready reference. For this reason, therefore, I have arranged Table No. 5, showing what can be most advantageously accomplished by any given pressure of steam ranging from 85 pounds to 155 pounds gauge.



PUMPING ENGINES FOR FERRYBOAT.



COMPOUND ENGINES.—SEE PAGE 1.

EXPLANATION OF TABLE NO. 5.

The greater part of this table will doubtless be sufficiently explicit without any lengthy explanation, but a few remarks on some of the more important points may be helpful. Reference will be made to each line by its number, and in their order.

INITIAL GAUGE PRESSURE.

Line No. 1. It is customary to speak of steam pressure as the steam gauge indicates it, viz., above the atmosphere, which is in reality about 14.7 pounds absolute, and commonly regarded as 15 pounds per square inch.

INITIAL ABSOLUTE PRESSURE.

Line No. 2. Note in Paper No. 3. "In dealing with the laws of expanding steam, always figure the pressures in absolute pounds, and not pounds above the atmosphere, as recorded by the steam gauge."

PROBABLE PERCENTAGE OF LOSS.

Line No. 3. There is always a loss of heat due to condensation, and which increases with the pressure of steam. The exact percentage cannot be predetermined, as it depends largely upon the quality of the non-conducting covering used on the cylinder, receiver, and pipes, etc., but will probably be about as shown.

TOTAL EXPANSIONS.

Line No. 4. The initial absolute pressure having first been reduced by deducting the percentage of loss, then divide by the terminal pressure in low-pressure cylinder, as per Rule No. 1, third paper.

EXPANSIONS IN EACH CYLINDER.

Line No. 5. It will be observed that the number of expansions in each cylinder is equal. This may be considered contrary to common practice, inasmuch as it is often found necessary to cut off later in the low-pressure cylinder than in the high, in order to equalize the load. But there is no theoretical reason why there should not be the same number of expansions in each, and at the same time develop practically the same horse-power. For reasons, see explanation of *Line No.* 12.

HYPERBOLIC LOGARITHMS.

Line No. 6. Any engineer's pocket-book, such as Haswell,

contains a table of hyperbolic logarithms, in which will be found opposite the number corresponding to the number of expansions the hyp. log. of that number; to this add 1. If such a table is not at hand, find the common logarithm of the number and multiply it by 2.3, and then add 1.

Lines No. 7, 8, 9, 10, 11 are all explained in the third paper, September 10, 1891.

RATIO OF CYLINDER AREAS.

Line No. 12. The relative area of the low-pressure cylinder to that of the high is governed by, and should be figured strictly in connection with the determined position of cut off in the low-pressure cylinder, for two important reasons.

First. To develop the same horse-power in each cylinder it is necessary that the effective area, multiplied by the mean effective pressure, should be equal in each cylinder; and since the mean effective pressure depends upon the position of cut-off, and the relative areas being established, the reason will be obvious.

To illustrate this, see *Example No.* 3 and *No.* 4.

Example No. 3.—By reference to Table No. 5, and under steam pressure 85 pounds, we see that the mean effective pressure in high pressure cylinder is 34.9 pounds, and in low-pressure cylinder 10.8 pounds; also that the ratio of areas for high-pressure is 1, and for low 3.23. Thus we have:

HIGH. LOW.

$1 \times 34.9 = 34.9 \qquad 3.23 \times 10.8 = 34.9.$

Example No. 4.—Under steam pressure 155 pounds we find the mean effective pressure in high-pressure cylinder is 54.8, and in the low 12.9; also that the ratio of areas for high pressure is 1, and for the low 4.25. Thus we have:

HIGH. LOW.

$1 \times 54.8 = 54.8. \qquad 4.25 \times 12.9 = 54\ 8.$

Second. The point of cut-off in the low-pressure cylinder should be established at such a position, relative to the area of the same cylinder, as to take from the receiver a volume of steam which shall be as near equal as possible to that supplied to the receiver by the high-pressure cylinder in the same given time. For if this is not so, and the piston be allowed in the first place to follow further than this point, an undue expansion takes place in the receiver and receiver piping, and there is objectionable wire-drawing in the steam passages. Consequently a considerable reduction will be observed in the initial pressure in low-pressure cylinder before cutting off. Or if, in the second place, the point of cut-off is too early, the volume will be compressed, causing a greater back pressure in the high-pressure cylinder, and probably a loop in the indicator diagram.

Fig. 1.

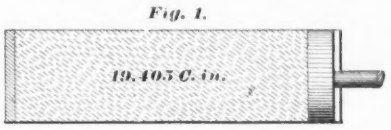
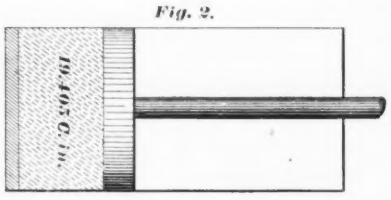


Fig. 2.



In order, then, to accomplish this object, and thus avoid the above objections, the clearance or waste space must be carefully taken into account, and included as part of the total volume of steam admitted into the cylinder at each successive stroke. The following reasoning and examples will serve to explain the theory.

The total volume of steam discharged from the high pressure cylinder into the receiver at each stroke of the piston equals the piston displacement plus the clearance; and the volume required by the low-pressure cylinder from the receiver for each stroke equals the piston displacement before cutting off, plus the clearance, thus:

Example No. 5.—In a two-cylinder compound condensing engine find the effective area of the low-pressure piston when the boiler pressure equals 85 pounds gauge, common stroke 60″, and the diameter of high-pressure cylinder 20″. Assume the clearance to be three per cent. of piston displacement in the high-pressure, and six per cent. in the low-pressure cylinder.

By reference to Table No. 5 we find, under initial pressures 85 pounds, that there are 3.88 expansions in each cylinder; that is to say, the piston moves forward $60 \div 3.88 = 15.4''$ before cutting off.

In the accompanying cut, Fig. 1 represents the high pressure cylinder with oblique broken lines as the volume of piston displacement, which equals the area multiplied by the stroke; thus: $314 \times 60 = 18,840$ cubic inches; and the oblique full lines as the volume of clearance, which is assumed in this case as three per cent. of the piston displacement, thus, $18,840 \times .03 = 565$ cubic inches. The total volume of steam contained in the cylinder at the moment of opening the exhaust valve equals the piston displacement plus the clearance, thus:

$18,840 + 565 = 19,405$ cubic inches.

Fig. 2 represents the low-pressure cylinder with oblique broken lines as the volume of piston displacement before cutting off, and as the cut-off takes place at 15.4 inches from the commencement of the stroke, the volume would be $15.4 \times$ area. The oblique full lines represent the volume of clearance, and equals $60 \times .06 \times$ area. Placing the volumes together for a total, we have:

$$(3.6 + 15.4) \text{ area} = 19 \times \text{area}.$$

Then, inasmuch as the volume taken from the receiver (as above stated) should equal the volume supplied to it in the same given time, which was found above to equal 19,405 cubic inches, we shall have:

$19 \times$ effective area $= 19,405$ cubic inches.

$$\text{or } \frac{19,405}{19} = 1,021 \text{ sq. in. effective area.}$$

Now, allowing that there will be a little loss, and comparing the ratio of cylinder areas on *Line No.* 12, and under 85 pounds pressure, which is 3.23, it will be seen that they practically agree. Thus:

$$314 \times 3\ 23 = 1,013 \text{ sq. in.},$$

showing a difference of only eight square inches, which is rather more favorable than otherwise.

It may be helpful just here to make a few further remarks on clearance.

CLEARANCE.

It will be noticed in the above reasoning that the clearance for the high-pressure cylinder is taken as three per cent., and in the low-pressure as six per cent. This, though approximate, is about correct, inasmuch as it is found that where the diameters are different, but of the same common stroke, that the percentage of piston displacement is greater in the larger cylinder. This is in consequence of its being figured in proportion to the displacement, and would not appear if the stroke was also increased in proportion with the area of the cylinder. This, however, would not be practicable.

The exact per cent. of clearance varies very much with the different designers of cylinders, but many of the first-class engine builders have reduced it to its minimum, by placing the valves as near to the bore of the cylinder as possible, and in some cases even in the cylinder heads.

It is evident that short-stroke engines are at a disadvantage in this respect, as the volume of steam taken to fill the waste space is almost as much in a short stroke as in the longer, except that the port openings might be rather greater for the long stroke. In most of the more improved designs, wherein the stroke approaches a good proportion to its area, it is safe in figuring to allow in a 12″ cylinder about 2½ per cent., and in a 60″ cylinder say six per cent. of the piston displacement.

It will be observed that the clearance has not been taken into account when figuring the mean effective pressures; this is intentionally omitted for simplicity, and also from the fact that any theoretical gain thereby is only about a fair compensation for the loss by condensation while expanding.

TABLE No. 5.

TWO-CYLINDER COMPOUND CONDENSING.

		Steam Pressure in Pounds Above Atmosphere.																							
		85	90	95	100	105	110	115	120	125	130	135	140	145	150	155
Line No. 1.	Initial gauge pressures	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170
Line No. 2.	Initial absolute pressures	2.5	2.6	2.8	2.9	3.1	3.3	3.4	3.6	3.7	3.8	3.9	4.0	4.2	4.3	4.5
Line No. 3.	Probable per cent. of loss	15	15.7	16.4	17	17.7	18.5	19.2	20	20.8	21.5	22.1	22.7	23.4	24.2	25
Line No. 4.	Total expansions	3.88	3.96	4.05	4.13	4.21	4.3	4.39	4.47	4.56	4.64	4.7	4.77	4.84	4.92	5
Line No. 5.	Exps. in each cylinder	2.355	2.376	2.398	2.418	2.437	2.458	2.479	2.497	2.517	2.534	2.547	2.562	2.576	2.593	2.609
Line No. 6.	Hyp. log. plus 1	60.7	62.9	65.1	67.3	69.4	71.4	73.5	75.4	77.3	79.3	81 3	83.2	85 1	87	88.8
Line No. 7.	Mean forward pressures	15.1	15.25	15.4	15.55	15.7	15.9	16 05	16 2	16 35	16 5	16 65	16 75	16 9	17.05	17.2
Line No. 8.	Mean back pressures	25 8	26.5	27.2	27 8	28.4	29	29.6	30.2	30.8	31 4	31.9	32.4	32.9	33 5	34
		4 3	4 3	4.3	4.3	4.3	4 3	4 3	4 3	4 3	4.3	4.3	4.3	4 3	4.3	4 3
Line No. 9.	Mean effective pressures	34 9	36 4	37 9	39.5	41.0	42.4	43.9	45.2	46 5	47.9	49.4	50 8	52 2	53.5	54.8
		10.8	10.95	11 1	11.25	11.4	11.6	11 75	11.9	12 05	12.2	12 35	12.45	12.6	12.75	12.9
Line No. 10.	Terminal pressures	25.8	26 5	27.2	27.8	28.4	29.0	29 6	30 2	30.8	31.4	31 9	32.4	32.9	33 5	34
		6 4	6.4	6.4	6.45	6.45	6 45	6.5	6.5	6.5	6.55	6 55	6.55	6 6	6.6	6 6
Line No. 11.	Initial pressure in low-pressure cylinder	24 9	25.3	26	26.6	27.1	27 8	28 5	29	29 6	30 2	30 8	31.4	31 9	32 4	33
Line No. 12.	Ratio of cylinder areas	3.23	3.32	3.41	3.51	3 6	3.66	3 72	3.8	3.86	3.92	4	4.08	4.13	4.19	4 25

Heavy Duplex Cutting-off Machine.

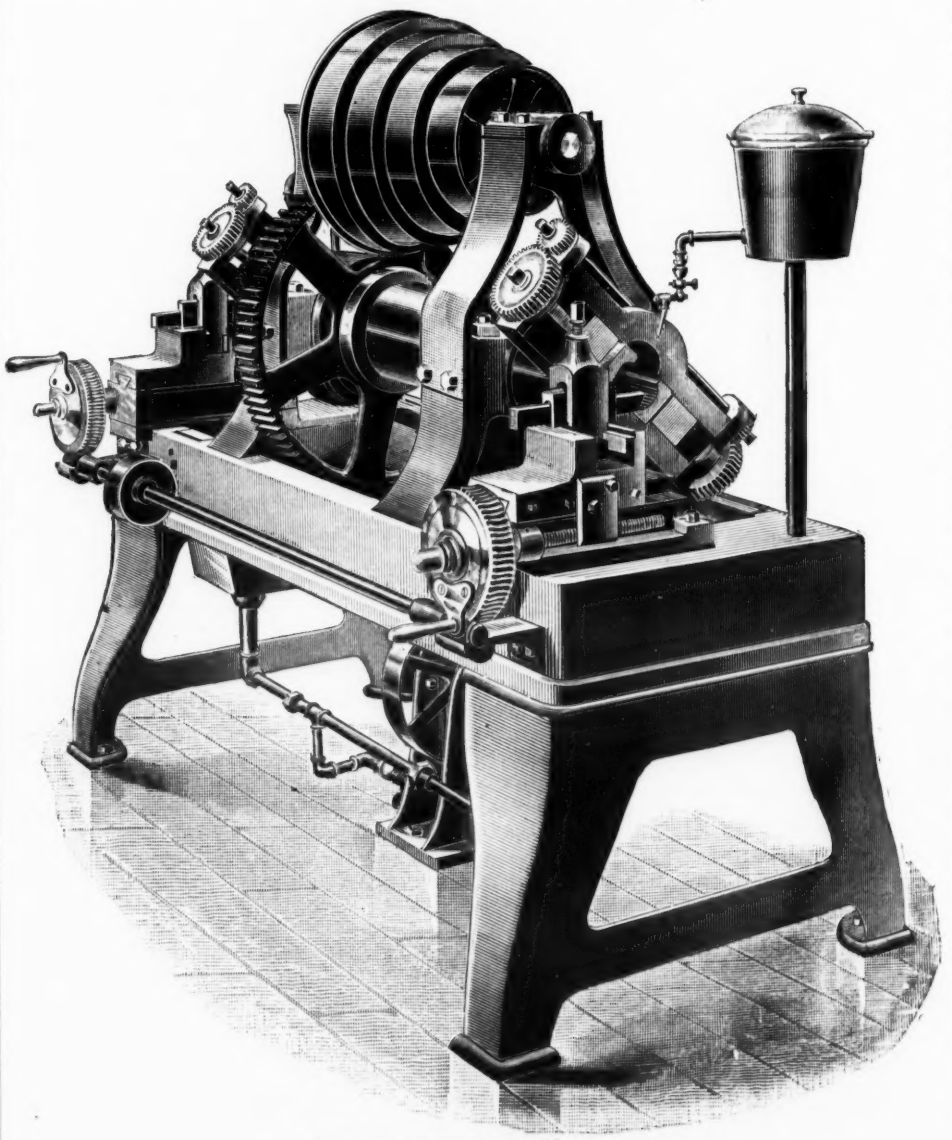
The illustration on this page is of a new duplex cutting-off machine, built for the heaviest work by the Brightman Machine Co., of Cleveland, O.

It will be noticed that in this machine the spindle is located in the middle of its length, and that there is a chuck at either end for holding the work. At each end there is also a cut-off slide and tool block, which may be fed either by hand or automatically. By this arrangement a shaft, when put through the spindle and cut off at one end, does not need to be taken out, turned "end for end," and replaced to cut off the second end, but need only to be shoved through to the proper distance to be operated upon by the other tool. The hole through the spindle is large enough to admit shafting up to 5″ diameter, and the machine is adapted to cut off all sizes from 1″ to 5″.

The bearings of the main spindle are 7″ diameter, and are two feet apart, the spindle being driven by means of the stepped pulley above, the largest diameter of which is 16″, with a width of belt of 3½″, and ratio of gearing of 6 to 1.

Particular pains have been taken to have the chucks amply strong and powerful for the heaviest work, and the jaws may be closed either by the application of the wrench to the screws direct, or to the supplementary shaft seen at the side, by which the gripping force is very much increased.

A pump under the machine supplies an abundance of lubricant to the tools. Other features of the machine will be readily understood by an inspection of the engraving. It occupies a floor space 6 feet by 2½ feet, and weighs about 2,300 pounds.



DUPLEX CUTTING-OFF MACHINE.

The idea of the Chicago man who proposes to dig the deepest hole on record, into which to lower visitors to the World's Fair, probably will not be carried out; still it has an element of novelty about it. It is a contrast to tall towers, which are becoming obselete.

A Model That Instructs.

In our issue of July 30, 1887, we illustrated and described a filter for filtering and purifying water, either in large or small quantities, the invention of James H. Blessing, and made by the Albany (N. Y.) Steam Trap Co.

Sand is the filtering material used, and animal charcoal the purifying material. By most ingenious and simple arrangements the filtering cylinders can instantly be put in connection with the sewer, and the sand washed entirely clean. The various operations of washing, aerating, etc., can be understood by a reference to the issue of the AMERICAN MACHINIST previously mentioned.

But, however clear any description of a device may be, witnessing the operation is more satisfactory. This, in the case of such a thing as a filter, cannot usually be done, because of the material of which it is made.

But the model to which we refer, and which can be seen at the works of the company named, is transparent, showing the operations going on in the cylinders for the several purposes.

This model is not a mere toy, as might be assumed, but is capable of going right along, and does go right along filtering and purifying a limited quantity of water. We saw some extremely dirty water supplied to it, and it came out, to all appearances, as clear as spring water. It is an excellent sermon—the operation of this filter—to the residents of a good many cities where the water is about the consistency of mud, and impregnated with all kinds of impurities.

The business of building these filters for private houses, public buildings and waterworks, is a large and a growing part of the business of this company, Albany forming a most important local field, in addition to the outside world.

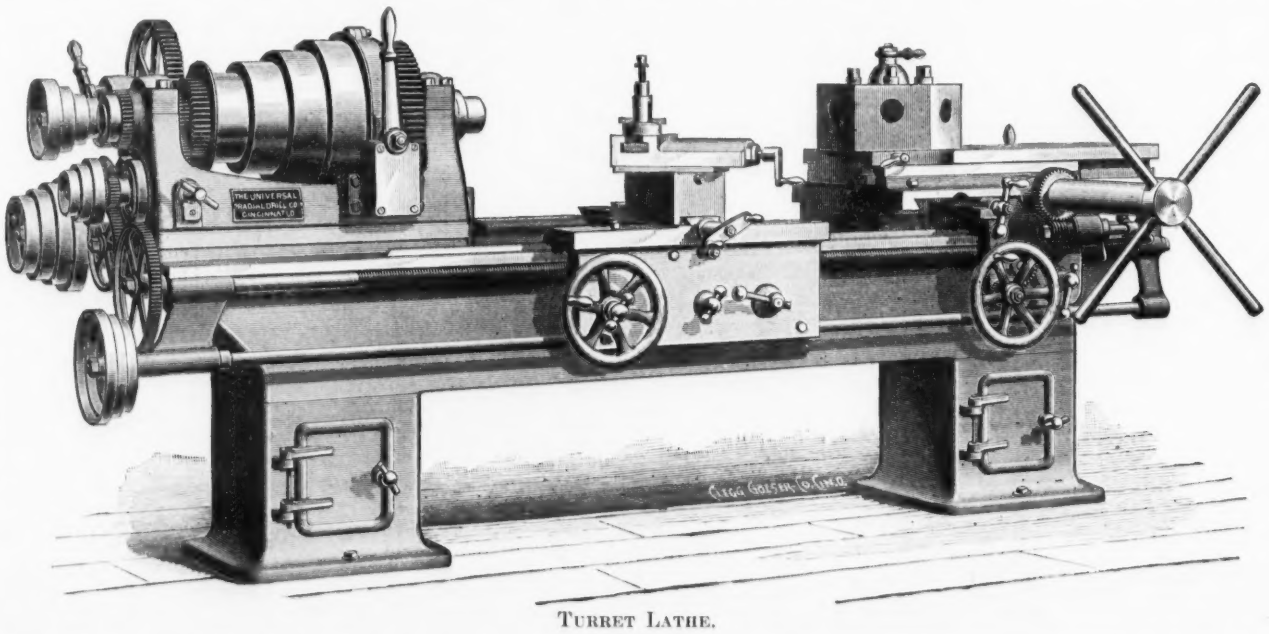
Of course, the "Blessing" steam trap, universally known, is a staple product of the company, while water circulators, steam pumps, pump governors, and brass goods—valves, etc.—fill in.

The shops are well arranged for their purposes, and work is carried on systematically.

A New Turret Lathe.

We illustrate on this page a turret lathe having some new features worthy of attention. The principal departure from the usual practice is in providing a machine of this type with a turret slide so arranged that, in addition to the regular movement of the turret in line with the spindle, it has a cross-motion of 5″, with a stop by which the turret is accurately centered again after it has been moved forward or back. Then, in addition to the regular automatic feed motion of the turret slide, and that by hand with the "pilot wheel," there is a slow movement by hand, which is effected by means of worm gearing attached to the pilot wheel shaft, this movement being available for very fine feeding or for burnishing. Then there is a still further additional series of movements which can be given the turret by means of an apron, which is attached to the front of the turret slide block, this apron being fitted with a hand-wheel and connecting gears to the rack, so that the entire block may be moved along, the same as a lathe carriage, or the nut which is attached to this apron may be closed upon the lead screw in the same manner as with a regular lathe, and any rate of movement obtained provided for by the change gears. Numerous applications of these various movements will readily suggest themselves to those having experience with machines of this type. The turret is hexagonal, to admit of bolting tools to its faces, and, while revolving automatically, is free to be moved by hand at a certain point in its movement, at which point it can be turned either forward or backward, as is often convenient, especially when only two or three tools are in use, and it is not advisable to turn the turret entirely around. The turret slide has a movement in the block of 18″; holes in turret, 2½″ diameter.

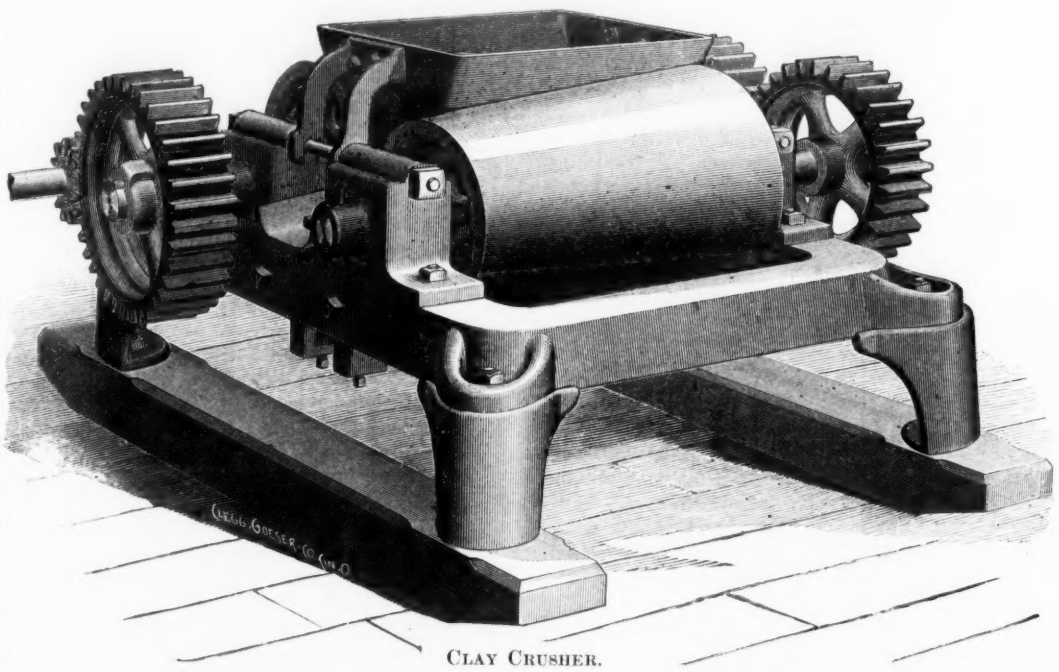
There is a regular lathe carriage which can be fed by rod or screw with automatic cross-feed, compound rest, etc., and the head carries a spindle of steel running in bronze boxes, the hole through the spindle being $2\frac{1}{16}$″ diameter. The width of belt, size of stepped pulley, and proportion of back gears, gives very strong driving power, and a lever in front of the head allows the speed to be changed from "back gear" to "cone pulley" speeds without stopping. The machine has a swing of 25″; bed, 9 feet long, is provided with reversing countershaft, and weighs about 3,700 pounds. It is built by the Universal Radial Drill Company, Cincinnati, Ohio.



TURRET LATHE.

Improved Clay Crusher.

We illustrate herewith an improved clay crusher which is intended to be used in connection with a brick-making plant, and has a capacity for crushing the clay needed for 40,000 bricks every 24 hours. As will be seen from the engravings, the machine consists essentially of a very heavy rectangular frame upon which is mounted the babbitted boxes, in which two shafts $2\frac{15}{16}$″ diameter are supported. These shafts are geared together and run at the same speed, upon them, between the boxes, being placed the chilled rollers which do the crushing. These rollers are tapered 24″ long, 14″ diameter at the small end, and 18″ at the larger, thus giving their surfaces what may be called a differential speed at every point except in the middle of their length. This differential speed causes the clay to be uniformly crushed, and at the same time the larger stones do not pass between the rolls, but are discharged at the ends.



CLAY CRUSHER.

The pillow blocks in which the boxes are placed are tied together at the top by wrought rods on which is placed the hopper, which can thus readily be removed.

There are scrapers below the rolls, which are readily adjusted from the sides of the machine, and all wear of any kind is readily taken up.

The machine is driven by a countershaft having tight and loose pulleys 8″x36″, and for the capacity mentioned should be driven at about 200 revolutions per minute. It is built by the Decatur Leader Manufacturing Co., Decatur, Ill.

A new steam launch, built to the order of W. K. Vanderbilt, and to be carried as a tender on his steam yacht "Alva," was launched from the works of C. L. Seabury & Co., Nyack-on-Hudson. Her dimensions are as follows: Length over all, 30 feet; beam, 6 feet 6 inches; draft, 28 inches. She is designed for heavy weather service, with a guaranteed speed of ten miles an hour. The hull is built of white oak; and planking, of selected mahogany.

She will be driven by a Seabury compound engine capable of developing 12 horsepower. Steam is furnished from a Seabury patent water-tube boiler.

The launch is very handsomely finished. Its weight is about 2,500 pounds, which is much less than that of the old launch carried on the "Alva," which was built in England, and, it is said, weighs 4,000 pounds.

Record of the "Bismarck's" Latest Trip.

The Hamburg-American line steamship "Fuerst Bismarck" made her last trip between New York and Southampton in 6 days, 12 hours, and 38 minutes, breaking the best previous record by 32 minutes.

She was built by the Vulcan Shipbuilding Company, at Stettin, Germany. Last May she commenced her maiden trip from Hamburg, and succeeded in smashing the record of maiden trips of all ocean steamships.

Her length is 502 feet 6 inches; breadth, 57 feet 6 inches; depth from upper deck to keel plate, 34 feet 6 inches; and is of 8,716 tons register.

The contract with the Vulcan Company stipulated 14,000 horsepower, and a speed of 19 knots. This contract, as the "Bismarck's" trips bear witness, has been more than carried out.

On Friday, September 11th, the Overman Wheel Company, makers of the "Victor" bicycles at Chicopee Falls, Mass., flung to the breeze one of the largest United States flags ever made (and possibly the largest), the dimensions being 41x71 feet. This monster flag was stretched from the top of two five-story factories, and gathered within the folds were numerous flowers which fell into the crowd below when unfurled. The mayor of Chicopee, the Overman Wheel Company band, and a large concourse of spectators witnessed the event. The flag is without advertising of any kind, being merely a national flag.

One of the best signs of general prosperity to come this fall is in the abundance of good crops. This means plenty of work for transportation companies, and money in the farmer's pocket. It means such a general stirring up of sluggish money circulation as will enable most men to get hold of a little of it; without this, business is dull. Good business comes from a good many men getting hold each of a moderate amount of money with which to pay for what they need. To a great extent we are all dependent upon the success of the farmer.

Lieut. J. F. Meigs, of the navy, recently found disqualified owing to color blindness, and now on the retired list, has accepted an important and responsible position with the big steel armor and gun establishment at Bethlehem, Penn.

The above item, which we take from a newspaper, bears out in a remarkable way our comments on this case of Lieut. Meigs in our issue of August 6.

The coal production of India in 1886 is said to have been 1¼ million tons; in 1887, 1½ million; 1888, 1¾ million; 1889, a little over 2 million; and in the official year ending in March last, 2¾ million tons. The imports by sea have diminished from 849,000 tons in 1886 to 460,000 tons in 1890.

Mechanical Flight.

BY WILLIAM H. HARRISON.

I noticed the article in the *Century Magazine* entitled "The Possibility of Mechanical Flight," by the Secretary of the Smithsonian Institution in Washington, and supposed that it was merely a bid toward relieving the overburdened treasury of some of the money which, outside of that city, is supposed to belong to the people, and passed it by as one of the inevitables connected with what we call government.

The AMERICAN MACHINIST, however, in its issue of Sept. 17, 1891, seems impressed with "the transcendent importance of such a discovery," and this is my reason for applying to this "discovery" a few of the ordinary engineering rules.

The experiments, so-called, appear to be merely the dragging of brass plates through the air at various speeds, the plates being inclined upward at the leading end; of course, if the plate is light enough it will float in the air when sufficient speed has been attained; if the speed is too low there will be a smashing against the earth, which will be very uncomfortable for the passengers. This, however, is not flight, it is not advancing beyond the principle of an ordinary boy's kite. The boy takes advantage of the wind to raise his kite, and often assists it by running to windward.

The usefulness of flight depends upon being able to get somewhere with freight or passengers, with reasonable safety, and the action of the wind, upon anything now known, which is so bulky as to float by its superior lightness, in the air, is so great as to prevent the use of the gas bag for anything but exhibitional purposes.

Screw propellers have also been proposed, both for lifting and moving those who would like to fly; but the same trouble—enormous areas—is met. John Smeaton, away back in 1759, recorded that to produce one effective horse-power with a wind-mill requires a diameter of 31 feet—the wind is supposed to blow with a velocity of 9 miles per hour, and the wheel makes 20 revolutions per minute.

The above-named troubles would seem to have suggested the kite experiments described by Professor Langley; for if the inclined plates were drawn through the air by *external* power, as by a locomotive running on a track, there is no necessity for any expenditure of power for lifting the *motor*. He says one horse-power "could transport and sustain in such horizontal flight over 200 pounds weight of loaded planes at the rate of 50 miles per hour." This, if true, would seem to be good; but let us see what the railroad people can do. Sir Daniel Gooch, who in his time was a most skilled designer of railway machinery, subjecting everything to experiment, made a table of the actual resistances of trains, and he recorded that the resistance of the train, or the pull on the draw-bar next the engine, at 50 miles speed was less than one pound for each 100 pounds total weight, and this on his broad gauge road.

Now, 50 miles per hour is equal to 4,400 feet per minute; 200 pounds weight in a train gives 2 pounds strain on the draw-bar; $4,400 \times 2 = 8,800$ foot-pounds per minute.

A horse-power is 33,000 foot-pounds per minute, hence, by Professor Langley's own figures, he expends $2\frac{2}{3}$ times the power to haul a given load. In other words, the one horse-power, which he says would haul 200 pounds weight—flying—would on a railway haul 533 pounds, both at 50 miles per hour.

But even this one horse-power is a tremendous under-estimate, as I shall proceed to show.

If we consider a case of a steel or brass plate 10 feet square, weighing 200 pounds, its weight per square foot will be 2 pounds, and its thickness $\frac{1}{20}$ of an inch. Let this plate be guided without friction, so as to fall flatways toward the ground, the speed will increase until the weight of 2 pounds per square foot is balanced by a plenum or air pressure beneath it of 2 pounds pes square foot. From the old tables of Professor Hutton, of England, we may learn that a wind blowing with a velocity of 2,050.2 feet per minute at right angles against a plane surface exerts a pressure of 2 pounds on each square foot. This table seems to take into account the slight vacuum formed on the lee side of the plate.

Now 2,050.2 feet $\times$ 2 pounds pressure = 4,100.4 foot-pounds work done per square foot per minute, and $4,100.4 \times 100$ square feet = 410,040 foot-pounds done by the whole surface, or $\frac{410,040}{33,000} = 12.426$ horse-powers.

If the plate were held in one place by a column of air blown upward with such force that the pressure below should exceed the pressure above by the required two pounds per square foot, then the velocity would be 2,050.2 feet per minute, as shown by Hutton, and the power required to keep the column of air in motion would be precisely the same, 12.426 H. P.

If the plate stood on four legs the *pressure* upon each would be 50 pounds, and *no power* would need to be expended for sustaining it in the air.

If it were upon wheels no *power* would be expended for holding it up from the ground, but if it were to be moved from place to place, power would be expended in overcoming the friction of the axles and other machinery, and the friction and head resistance of the air, which are the same in both cases.

Take again the case in which the plate weighing 200 pounds is stated as having been sustained in the air while traveling at the rate of fifty miles per hour; no angle of inclination is stated, but we will assume that the inclination from horizontal was 25°. Using Hutton's tables we find that the pressure against a plate, with a wind blowing square against it at that speed, is 9.4 pounds per square foot, and the pressure at the angle of 25° is .234 times that, or $.234 \times 9.4 = 2.20$ pounds. Now this pressure is not in a perpendicular direction as regards the earth, but is 25° from it; then the true lifting force is found by multiplying 2.20 by cosine 25° = .90631, or $2.20 \times .90631 = 2$ pounds lifting force for each square foot of the plate, or 200 pounds in all, which is the weight of the plate.

The horizontal strain is found by sine 25° $= .42262 \times 2.20 \times 100 = 93$ pounds for the strain on the tow line; 50 miles per hour = 4,400 feet per minute, and $\frac{4,400 \times 93}{33,000} = 12.40$ H. P., which is the same as is shown by my calculation on the plate falling flatways, as indeed it should be.

I do not know how Hutton's table was made, but I should expect to find great irregularities in any experiments made upon air in motion.

It will be noticed that at the angle of 25°, which I assumed, the 200 pounds weight of plate floating through the air at a speed of fifty miles per hour are exactly supported about as stated by Professor Langley, on 100 square feet of surface, which surface I also assumed.

If the angle be slightly increased more weight can be carried, but the tension on the tow line must be increased, and the power must be increased, for in the mechanical world there is no way to get something for nothing.

There is one thing we do get, and that is friction, of which no account has been taken.

It seems to me that a little study of Hutton's tables would have saved the four years of experimenting, the final result of which is twelve and a half times too small.

I do not know what sort of engines they have in the Smithsonian Institution, but all that I know anything about have boilers to supply the steam, and the lightest of these is the Herreshoff.

One of these in the "Vedette" boat, reported upon by Mr. Isherwood in 1882, when driven to her highest speed with perfect fuel, indicated 170 H. P.

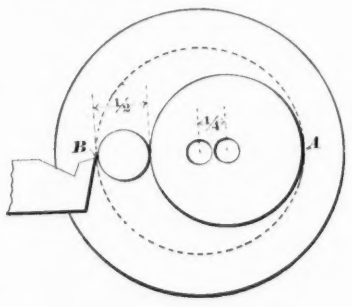
The engine, without the shaft, weighed 1,450 pounds, and the boiler, without the separator, 3,000 pounds, making 4,450 pounds. The engine, if worked non-condensing, as it must be on a flying machine, would not indicate more than 140 H. P.; then $\frac{4,450}{140} = 32$ pounds weight per H. P.

A non-condensing engine will discharge into the air 30 pounds of water, and burn under the forced blast five pounds of fuel per hour per indicated H. P.

We have, then, for one indicated horse-power, and the water and fuel for one hour, 32 + 30 + 5 = 67 pounds weight, while Professor Langley puts it at "considerably less than 20 pounds weight, everything, including fuel for a short flight, included."

I have shown that, by theory, say 12.5 H. P. would be required to support our plate when flying through the air. It will be necessary to double this for overcoming friction and other losses, which makes 25 indicated H. P. required from the engine; then $67 \times 25 = 1,675$ pounds for machinery, water and fuel, and 100 pounds must be allowed for the plate, which then will be only $\frac{1}{40}$ of an inch thick, making 1,775 pounds weight, and not counting in the screw propellers, or the engineer; and it is certain then that with but 200 pounds of lifting force that this thing cannot think of flying.

After all that has been said about the possibility of machine flying, of what practical value is it? I can see none; no one wants to trust his life to a vessel, in which the mere stoppage of the engine is going to drop him in an instant, to say nothing of troubles of getting under way and coming to port. If we wish to overcome the action of gravity, there is a much better way than by churning air with screw propellers. An ordinary stone cart with a half a ton of rocks tumbled into it, and an old horse to drag it, becomes, from my point of view, a perfect flying machine. The wheel spokes hold the weights up in the air without any expenditure of power, and the horse pressing against the ground overcomes the friction of the axles, and keeps the thing moving.



Boring an Eccentric Hole.

Last week we published an article by "A Mechanic," in the manuscript of which there was a point not brought out very clearly, and to avoid the appearance of a mistake we made some changes, the nature of which will be understood by reading the letter below, which was written in response to our inquiry. The net result of this is that both methods are given, and our readers can choose between them. The letter is as follows:

In regard to setting the disk on a face-plate there seems to be a misunderstanding. I think you understand it this way: With the work true in the lathe, bring the tool in contact with the rim of disk, then set the work over till the $\frac{1}{16}$ plug will go through between point of tool and rim of disk, with the face-plate of lathe in same position. This is not the way I worked, although this way would be good on the start; but for a final test, I claim greater accuracy can be got by revolving the face-plate. Set point of tool *B* (in sketch enclosed) to come in contact with point *A*, which is the point of greatest throw, then turn face-plate halfway round, and the open space (when set right) will, of course, be twice the distance the hole to be bored is off center; therefore the reason why I used a $1\frac{1}{8}$" plug.

I did not mean to measure with it what the work was off center, but the whole amount that work run out of true, which, of course, is twice what it is off center. By this way I am able to divide the error one-half. Now this presupposes that the work is true in the lathe before boring the second hole; but we often have quite a different job to do.

A short time ago I had a jig to correct, where there had been a mistake made in the spacing of two holes; they were $\frac{1}{16}$" out of the way.

I wanted to make an eccentric bushing with the hole, of course, $\frac{1}{16}$" off center. The most convenient way at hand to do this was to turn up on a bar, on lathe centers, a plug, to fit the hole in jig, and after making it the right diameter, cut it off the length of bushing wanted. Before cutting it off I had made sure that one end was slightly "dishing." I then clamped the plug to the face-plate so as to bore the hole. Now if I had intended to set the piece off center by using the $\frac{1}{16}$" plug (as first mentioned in the letter), I would have at first to true the piece; this would be unnecessary work, for I used the $\frac{1}{8}$" plug and made the piece run out of true this amount, as before mentioned.

If I had reason to suppose that during the boring the piece had moved, I could have easily tried the plug again at any time.

I only write this to explain why, and how, I used the $1\frac{1}{8}$" plug. Whichever way you show it will be agreeable to me.

A MECHANIC.

LETTERS FROM PRACTICAL MEN.

Mean Effective Steam Pressure.

Editor American Machinist:

In your issue of 17th inst. I find a letter from Geo. E. Reid, giving a method of ascertaining the average pressure of steam when the initial pressure and number of expansions are known. The following method, described in the September number of *The Compass*, making use of gauge points, seems to me much simpler, as they may be used for ordinary arithmetical computation, or with the slide rule, for which they are particularly suitable.

Portion of stroke at which steam is cut off.	Initial G. P.	Average G. P.	Portion of stroke at which steam is cut off.	Initial G. P.	Average G. P.
7/8	250	248	1/10	167	151
3/4	55	53	1/9	214	164
5/8	37	34	1/8	3	2
1/2	13	11	1/7	23	12
3/4	31	23	1/6	100	33
1/4	57	34	1/5	68	67
1/8	13	5	1/4	16	15
9/10	200	199	3/10	10	7
7/8	139	136	2/5	43	20
1/10	139	132			

Example.—Given an initial pressure of 61 pounds per square inch, with the steam cut off at one-fourth of the stroke, making the absolute initial pressure 61 + 14.7 = 75.7 pounds.

Average pressure $= \frac{75.7 \times 34}{57} = 45.15$ pounds, from which deduct the absolute back pressure, or 1.5 + 14.7 = 16.2, and we have 29.13 pounds as the mean effective pressure per square inch of piston.

For the slide rule we have

Scale *C*	Set *I. G. P.* 34	Under 75.7 pounds.
Scale *D*	To *A. G. P.* 57	Find 45.15 pounds.

WM. COX.

How it Looks to an Outsider.

Editor American Machinist:

In the bliss of ignorance the builder of engines is sometimes tempted to criticise the builder of railroads.

The requirement of railroading seems to be concentrated into the locomotive, and almost any kind of a track is good enough for it to run on. An examination of the rail joints while a heavy train is passing discloses a vertical wig-wag motion that would look very ugly in any piece of machinery, and the body of the rail is not free from such motion—a half an inch or more is the usual thing. Some of the ties are suspended to the rail and have literally no bearing on the ground; in such instances the supports are over thirty inches apart, and the deflection of half an inch hundreds of times a day bespeaks disaster *en avant*. The weight of locomotives having increased until 100 tons is within the limit, the section of the rail appears to be mechanically insufficient. It is true, steel is substituted for iron, and the fish plate joint adds to the lateral, if not the

vertical stability; and since so few rails break, it may be assumed, with a mental reservation, that the strength is all right, with a low factor of safety. Compared to the guide bar of the locomotive, the rail is inferior in section, while the strain is many times greater. On roads where the rail joints are suspended the strain is greatest at the ends of the rails, for it has then only the strength of its own section, whereas other parts of the rail, supported each side of the weight, have double strength. The fish plates contribute next to nothing to the strength of the rail, for they are always loose.

The supported joint is not always supported, for that tie is as liable to be loose as the others unless carefully watched, and careful watching is onerous at $1.15 per day. No attempt is ever made to prevent the rails from spreading except the tie itself—which is frequently half rotten—and the lateral stability of the rail. The ballast usually consists of gravel with enough of earth in it to retain the moisture, and the drainage is not always good; hence the decay is rapid.

An engineer who would erect an engine for a permanent works on a wooden foundation would be called a lunatic, but anything appears to be good enough for a railroad. If the speed of the trains was infinite, and the track level and straight, there would be literally no pressure on the rails, and paradoxically the greater the speed the lighter the rail; but under existing conditions there is an inverted wave traveling continually under each truck and driver, that points to the necessity for a heavier rail.

On the best ballasted roads this wave motion is hardly noticeable; but all roads are not well ballasted; besides, the rails are frequently worn and frayed at the edges, and weak and battered at the ends, and when we consider the fact of a fifty-ton locomotive jumping on it with its feet a dozen or two times a day the immunity from accident is wonderful. No builder of machinery would care to handle such strains with such slender material, and with such unstable support. The passenger on a steamship congratulates himself on having three-quarters of an inch of steel plate backed up by ample steel ribs between him and the ocean; but he who travels by rail has but the rotten ties between him and perdition, and must needs leave hope behind. C. W. CRAWFORD.

Some Points About Taps.

Editor American Machinist:

There seems to be considerable difference in the opinions of mechanics about whether taps need backing off in the thread or not.

I think I am safe in saying that for taper taps, at least, backing off in the thread is not out of place. A taper tap will not cut so well as a straight one without backing off, for the outside of teeth on back side of flute are on a larger diameter than on face or cutting edge, so a very steep taper and a very coarse thread tap might not cut at all without backing off, but just wedge the stock back.

This would not be a cutting tool, but a squeezing tool. It seems to me, if I remember correctly, I have seen a great many of these squeezing tools, in the way of taps and dies. In the instance of a taper tap of 12 P., at a point 1″ in diameter, a taper of $\frac{1}{16}$ to 1, with a flute $\frac{1}{4}$″ wide, the diameter across two outside threads, at the back side of flute, is between .0004″ and .0005″ larger than across the same threads at the cutting edge. This is a small amount, to be sure, but considering where it is, it is an appreciable amount just the same. It will be seen by this that a common taper tap will need a *little* backing off in the thread, to make it equal in its cutting action to a straight one without backing off at all.

In a tap factory, where they can afford to have a special machine to do this backing off, it need not be so very expensive, but in the ordinary machine shop the case is a different one. Perhaps this will call to the minds of many of the readers of the AMERICAN MACHINIST the back-aching jobs they have had at backing off a large tap with a three-cornered file, and how exceedingly tired they felt after finishing the first flute, and looked at the rest of them many times, to see if they could not make some mistake in counting them just to help their feelings. When I have a job of this kind to do, it always sets me to thinking. There is a saying, "Necessity is the mother of invention," but I think that laziness is the mother of a great deal of it.

When I have a large, long tap, with six or eight flutes, and a fine thread to back off, I must confess *I am lazy*. I had just as lief go home as stay. As I have shown before in this letter, there is very little to come off, if it is taken off evenly. I do not think it necessary to have a gradual slant clear to the cutting edge, as in a lathe or planer tool, but if the surface is taken off a little, to within say $\frac{1}{64}$″ of cutting edge, and leave off abruptly, it will do. It is only necessary to get the stock off, so it will not bear the whole length of tooth. I have been trying some experiments with acid to do this.

I took a common pipe tap that had not been backed off, put a lathe dog on shank to turn it by, used a piece of $\frac{7}{16}$″ round iron for a lever to turn the dog with, and tapped into a hole till the lever bent. I then found, on taking the tap out, that it had made about one-half thread in hole. I then backed the tap off in the thread with acid, after which I ran it into the same hole again, with the same dog and lever to turn it with, and found I tapped right down to a sharp thread before the lever bent, which I think shows that the tap cut much better than before. The advantages I claim for this acid plan are these: It is less work than with a file. When a straight tap is new, it does not need backing off, but when it gets worn it does, and so the acid will do the job then without drawing the temper, and make it about as good as new. I don't know that anybody ever tried to back off a square thread tap in the thread; if they did, I would not wonder if they found it quite a job—that is, by a hand process.

When such a tap is new, it does not need backing off, but when it gets old and worn, and comes out about as hard as it goes in, a little acid properly bestowed upon it I believe would save muscle if nothing more. I suppose there is a good chance for improvement in applying the wax, or whatever is used to protect the cutting edge from the acid, over what I have to suggest. I tried several plans. First I tried narrow strips of pasteboard, with one side covered with wax warmed a little, and pasted them right along face of flute, thinking that the wax would flow back a little in thread; but that did not suit me. I then tried dipping each flute into melted wax, by using a square, shoal, tin pan, and tilting it till the wax would almost run over, I could then lay the face of flute right into the wax, but I did not find this satisfactory.

The most satisfactory way I have found is to take a small strip of soft solder, and hammer it into the thread, after which I straightened one edge with a knife, so as to use it for a gauge to keep the wax where I wanted it. I can hold this back any distance from the edge I wish, and then take a mixture of lard and beeswax and rub it into the thread cold. I used a mixture of nitric and muriatic acid, one-half of each. Perhaps some of the readers of the AMERICAN MACHINIST will make some good suggestions. Of course we can dip the whole tap into melted wax, and then, after it is cold, scrape it off where we do not want it with a chaser, but I am looking for an easier way.

I have a little to say about nut taps. I mean the long ones where the shank is turned taper a part of the way, and the thread is cut straight all the way. Such a tap finishes the point of thread in nut when it first starts, and then if it "runs" any it begins to damage what it has finished. This "running," I think, is usually caused by what the tap changes in hardening.

Some people pretend to be able to do some mysterious things in hardening steel, but I think the best of them can't keep some of these long taps from changing in hardening, if they feel inclined to go that way.

I have no doubt but, if the stock for a tap is first roughed out, then hardened and annealed, and then finished and hardened again, that as a general thing it could be expected to come better than if this extra precaution was not taken; but I would not be too sure that they would always come better. I wish to suggest, for an improvement in nut taps, that they be made as now for a part of their length, but say for a $\frac{3}{4}$″ tap, .01″ under size, than to come to a regular taper part, not a taper in the blank, but a taper thread, this taper to extend to size, and then a short straight thread. What would be just the same would be two or more taps, the second one to have the taper thread on the point, so that it would well enter after the first one.

I claim this would finish all over the thread last, which would be better than finishing a part first, and then tearing it off with a later arrival. A MECHANIC.

Municipal Coal Yards.

Editor American Machinist:

I have just finished reading your editorial, "Where a Distinction Should be Made," and while I like it in the main, it seems to me you hardly understand just what is aimed at in the movement to have the cities sell coal.

As I understand it, it is to help the *very* poor—people that cannot afford to buy by the ton or half ton, but by the basket. Widows, girls, and quantities of poor people buy so for the reason I have named, and because in some cases, perhaps many, they have no room to store more. I am a machinist at good wages, and buy by the ton, and don't expect much benefit from the movement, but once I borrowed a basket, such as grocers sell in, and measured a ton that had been put in the bin that day. At the asking price per basket the ton would have cost me nearly $12. I paid $6, and am better able to have paid the other price than those that do pay it. Isn't that an evil that ought to be *fixed?* Hasn't the fact that laws, and "amending" of laws, have practically no effect on monopolies, been pretty well proven the past few years? Hasn't money combined to make the laws so that they may be broken down easily? I think so, and while I don't say this "Nationalist" idea is the best one that could be found, I do say it is a good one, and looking in the right direction, and I cannot see where it does away with any legitimate ambition. HOWARD P. FAIRFIELD.

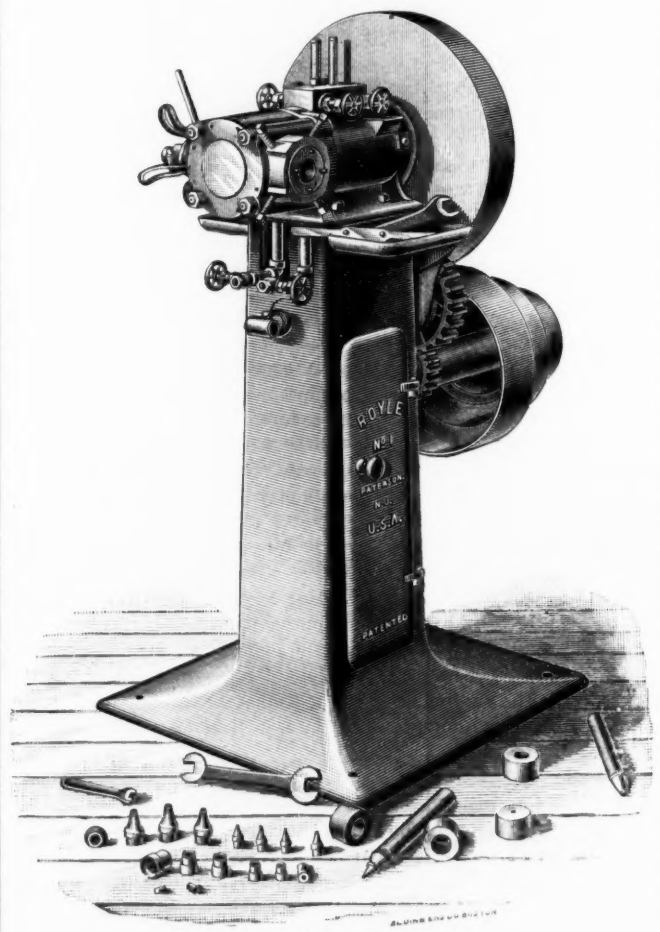
Boston, Mass.

Insulating Machine for Electric Wire and Cables.

The insulating machine, of which we give a perspective view and illustrations in detail, is specially designed for covering cables and wire, used in electrical and similar appliances, with rubber or some other plastic compound.

The mode of operation is very simple. The plastic compound is fed in the small spout, triangular in appearance, on the side of the cylinder shown in Fig. 1; from there it flows to the stock feed screw *E*, working in a steel-lined cylinder shown in Fig. 2, page 7, which conveys the compound to the chamber in the head *H*, and from thence to the die *D*, where it comes in contact with the wire to be covered. The wire enters the head at the rear, and is delivered, covered with the compound, through the die at the front of the head.

The principle of construction involves some important features, and the most important ones are found in cylinder *C* and its head *H*, shown in Fig. 2. The important features of the head are the provisions made for changing and holding the die *D*, for centralizing the wire or cable, and adjusting the tubular holder *B*, and the feature common to both cylinder and head is the means provided for keeping the plastic compound at a given and constant temperature.



INSULATING MACHINE.—FIG. 1.

The die *D* is made of steel of thimble form, and fits into a cylindrical holder by which it is kept in place, and these are held in position by the hollow plug *K* screwed in the head. With this form of die the changing is quickly done, the operation in no way interfering with the adjustment of the core D_2. With a few holders quite a number of dies of different diameters may be used, thereby affording a large assortment of dies at nominal cost, varying in size by very slight measurements, if desired, so that the dimensions of the product may be closely gauged by simply inserting the most suitable die for the work. The dies are adjusted to an accurate central position relatively with the core by four set-screws (not shown in the illustration), and this can be readily effected without disturbing the axial alignment.

The cores D_2, used for centralizing the wire or cable, are made of steel, screwed into, and made interchangeable with a series of tubular holders *B;* these are carefully ground and nicely fitted to a fixed socket provided within the head. The holder *B* is adjusted longitudinally to the proper working point relatively with the die by the threaded gland *k*, which engages with the sleeve *l*, the latter being clamped to the holder *B*, which, after adjustment, is rigidly secured against lateral pressure of the flowing compound by the conical split rings *f f*, which are caused to tighten around the holder by the threaded gland *g*. All this can be done while the machine is in use, without disturbing its true alignment.

The head is arranged so as to deliver in either a vertical or horizontal direction, as may be desired, by simply changing its position on the four bolts with which it is secured to the cylinder.

From the foregoing it will be seen that, by simply unscrewing one plug at the front,

the die can be changed without disturbing the head of the machine, and by loosening one bolt through the sleeve *l*, and loosening the conical rings *f f*, the tubular holders can be changed; and either one can be removed independently of the other.

The provisions made for keeping the plastic compound at its proper consistency, which is about like that of putty, consist of a circulation of cold water or steam through the cylinder and head, as occasion may require. The cold water enters the upper chamber in the cylinder through the opening *W* shown in Fig. 4, and the steam enters through the opening *S*, and the flow of water or steam is regulated or cut off by ordinary valves bearing against the surfaces *i i*. These valves and spindles are similar in form to those of an ordinary globe valve, and the hand-wheels on their spindles are plainly shown above the cylinder in Fig. 1. The cylinder is provided with circumferentially circuitous passages *e e*, into which the steam or water can enter through the passage *m* (Figs. 2 and 4), and these can also enter through the passage *b* into the channels in the head and around the die, which is entirely submerged within the walls of the head. This circulation affords an excellent and effective means of preserving the temperature of the compound through all the stages of its travel, and at the point of its delivery.

The machine is powerfully geared, and the new form of bushing at the back of the cylinder, upon which the large gear is revolved, is an improvement of the machines formerly built by the same firm.

To clean the machine, the stock feed screw *E*, which is made of steel worked from a solid bar, may be readily removed from the back of the machine without disturbing the large gear, and the head can also be removed by unscrewing the four hexagon nuts shown at the front of the machine. The cylinder is supported by a heavy cast-iron column, in which is made a convenient closet for holding wrenches and other small accessories.

The machine, as will be seen, is of a neat and compact design. It has been in practical operation, and has given good satisfaction.

The floor space required is 24x33 inches; the weight of the machine is about 1,000 pounds. The largest die used is one inch in diameter.

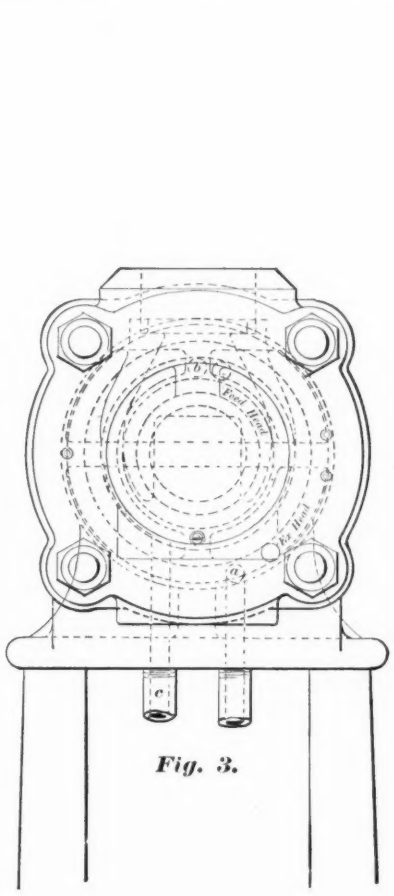


Fig. 3.

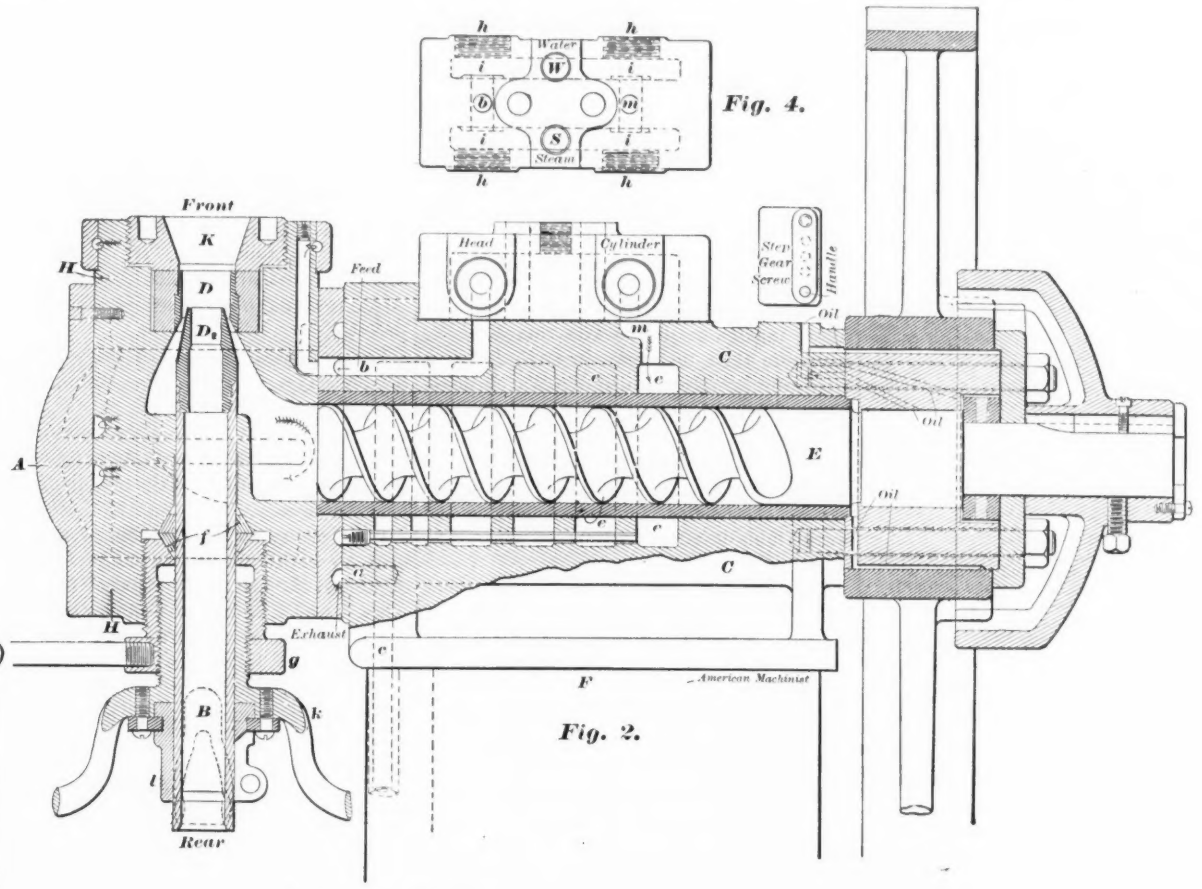


Fig. 2.

Fig. 4.

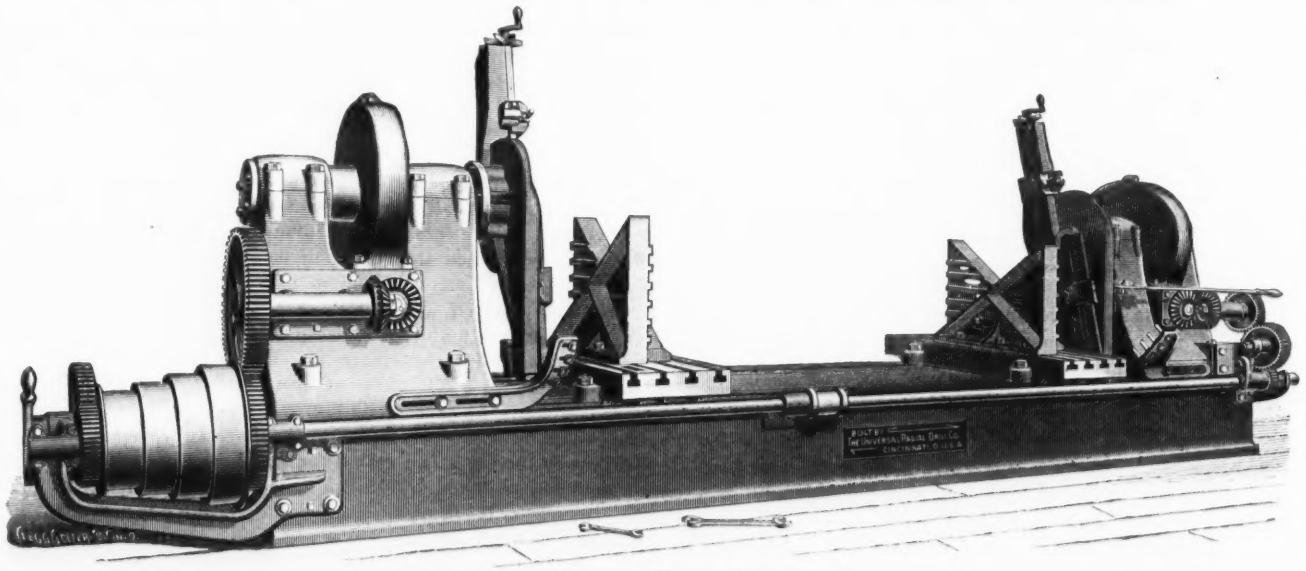
INSULATING MACHINES.

A countershaft is furnished with it; the shaft has self-oiling universally adjustable bearings, light and loose pulleys 14x4 inches, and a cone having speeds of 8, 11 and 14 inches diameter for a 4-inch belt.

These machines are manufactured by John Royle & Sons, Paterson, N. Y.

Double-ended Facing Lathe.

The accompanying illustration represents a new machine recently brought out by the Universal Radial Drill Co., of Cincinnati, for the purpose of facing the ends of iron pipes, columns, architectural work, etc., the first machine having been constructed for the Addyston Pipe Works, where it is used for facing flanged pipe.



DOUBLE-ENDED FACING LATHE.

The pipe or column is placed on the adjustable V blocks, these blocks being mounted upon platens which are adjustable along the bed of the machine, one of the facing heads being also adjustable on the bed, so that any length of work within the capacity of the machine may be faced with equal facility.

The heads are driven by worm gearing, securing a very even and steady motion, each spindle carrying two facing arms, so that roughing and finishing tools may be used simultaneously when desired.

The feed is by the well-known star device, and variable by using various numbers of the tappet pins, which are supported in a bracket attached to the heads, so that they have sufficient adjustment endwise to make them engage with either side of the stars, so that feed can be in either direction. Work from 4" to 58" diameter can be handled on the machine, and the bed can be made of any desired length, the distance between the facing arms being 9 feet less than the length of bed. With a 23-foot bed the machine weighs 30,000 pounds.

A correspondent writes us: "I am about to build a small foundry (of wood) for about six molders, and would be pleased if you would ask for plans from your correspondents, that I, with others, might get the benefit of those who have been through the mill. I would like a plan of best way to get light, frame for roof, etc. My work is general jobbing and stove work, mostly light, with quite a lot of plain castings. Would need one crane, as we make some gears about 1,000 pounds weight."

[We have shown plans of several large foundries. Can some of our correspondents help the inquirer by giving a good plan for a small one?]

Naval Contracts Awarded.

The contract for constructing torpedo boat No. 2 has been awarded to the Iowa Iron Works of Dubuque, Iowa. The report by the naval officers sent to these works, to judge of its efficiency for constructing this class of boats, was very favorable. Secretary Tracy also made a formal award of contract to the Cramps, of Philadelphia, for the construction of cruiser 13. The contractors, on the Secretary's assurance of action, have already begun work on this cruiser, so as to gain on the specified time.

Of course all concerns that are directly interested in machinery to any great extent are fully posted long since on the methods of operation of Fink, whom we first exposed several years ago. Our exposure has compelled him or his successor to avoid the manufacturing establishments where he is too well known, and to seek only those where machinery, and consequently lubricating oils are used, but where the AMERICAN MACHINIST is thought by him to be less generally read. Some one who was evidently pursuing Fink's methods, and who possessed the famous book of commendatory letters formerly carried by him, undertook to sell the receipt to a concern in Pennsylvania a short time ago, but there happened to be employed in the office a mechanical engineer who reads this journal and was fully posted. The result was that no contract was signed, and the book lost one of its autograph letters. It was noticed by this engineer that the year in which the letters had been written had been erased with acid, probably because the date is now getting rather old, and people might be inclined to inquire why some more modern recommendations were not secured.

A decided improvement has been felt in the anthracite coal trade within a few weeks.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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Patents and Patent Law.

There is scarcely a question at the present time as to the value of judicious and properly executed patent laws. No man is likely to spend his time in the study of invention unless there is hope of his reaping some reward for what he does. Invention in almost anything generally stands for about the hardest kind of work—that of concentrated thought—and men will not as a rule do that kind of work without hope of rather tangible reward.

A man may do some inventing in the way of producing a steam engine, for example, because he expects what he invents to help him along in the business of building steam engines; help him in the way of enlisting capital, or in the better use of the capital he may already possess. There is no philanthropy in the matter. A man does not cudgel his brains to change existing affairs, mechanically, simply for the good of mankind; that is, he does not do this as a rule, any more than he works in any other way from the impulse of disinterested benevolence. He has hopes of making money from the mental effort he puts into the creation of his brain, just as he would expect to make money from something he made with his hands. And every civilized country in the world finds it advantageous to encourage this.

The fact that men are protected in what they evolve from their brain has done a good work in making countries great commercially, and all who give the subject intelligent thought admit the absolute necessity of liberal patent laws.

The fact, however, should not be lost sight of, that while the patent laws of this country are what may be called liberal, still the patentee pays for all he gets. He not only pays all that it costs the government to run the machinery incident to the issuing of his patent, but he pays a sum that secures to the government a very fair profit indeed on the business. Unlike most of the business transacted by the United States Government, the business of issuing parchments to inventors is a paying one. As the business is done, the government makes money out of the inventor. It builds new buildings and improves processes all at the expense of the inventor; he pays the bills all the way through, and helps to pile up a very neat surplus for the people.

The inventor does not find much fault with this. The cost is reasonable, and as he is rather certain, in his enthusiasm, that his invention will work a revolution, he is satisfied so far. The dissatisfaction comes later on. If he has covered something of importance, the fact that his claims have gone through the patent office, giving him what he assumes to be a clear bill of rights, is usually delusive, and far from settling the case.

The business of the Patent Office has grown so enormous that under present management but little more can be done than to issue a certificate to the effect that John Doe, or some one else, as the name may be, has put in a claim as the inventor of a certain device, or combination of devices. It is substantially impossible, or it appears to be, to determine whether or not some other one has not invented—and secured the papers necessary to show it—just about the same thing years before. So enormous has become the business of the Patent Office, and such a mass of matter stands behind its present proceedings, that, in the manner business is now done, it seems practically impossible to avoid conflicts of the most palpable kind in the granting of patents.

It should always be borne in mind that patents often hinge on what might be considered small details. That is, their value over something that may have preceded them may depend upon some very small change, which may nevertheless be important.

Patent Office examiners cannot constitute themselves a court of last resort in such cases. Hence there must be a resort to properly constituted courts.

And here is where the real trouble of the inventor begins. Pushed by a good attorney, his case may have gone through the Patent Office clear. But if it relates to something of general use he is likely to find that the real work has only begun.

Infringement is now the rule, and suits for infringement the order. This state of affairs might be tolerated were it not for the fact that it seems impossible, in the ordinary life of an inventor, to terminate such a suit. It drags itself along through the life of a patent, if it happens that the inventor has money enough to fight it—which is not often the case—drags itself along through the life of the patent, preventing its use, to the detriment of every one directly interested, and to the detriment of the people who are popularly supposed to gain advantages by the privileges granted the inventor.

It is this delay of the law that the inventor—and as well the people at large—have a right to find fault with. It is absurd—the idea that a patent case should be allowed to go along through ten to fifteen years of law practice.

If the general business of the world were conducted on the same plan, things would be just about at a standstill.

That patent cases are thus conducted is discouraging to the inventor, and it prevents his getting capital to help him along with his inventions.

If necessary to the dispatch of this business, an entirely separate court should be organized for the rapid disposal of patent cases. And it would not hinder matters if the judges, in addition to some knowledge of law, had a good deal of knowledge of mechanics and mechanical matters. If this were so, the inventor would stand a better chance to get justice, and he might get it during his lifetime.

Patentees pay their own expenses, and the business has its peculiarities—such as a time limit, for instance—that, in our opinion, would warrant provision by the government for settling matters connected with patents with the least possible delay, instead of dragging them through the almost interminable delays of ordinary law courts.

Municipal Coal Yards.

On page 6 of this issue will be found a letter on the above subject from a machinist living in Boston. In this letter our correspondent, evidently from the very best of motives, criticises our remarks under date of September 3, and attempts to show how many deserving people would be benefited by the establishment of coal yards by the city, at which coal would be sold at or near cost.

We do not consider it to be within the province of such a journal as this to go into an extended discussion of social questions, and we only refer to them when we think we can give information which may form a basis for independent and clear thinking upon the part of the many mechanics and others who are our readers, and who have little time and often little inclination to make a thorough study of economic matters, and are therefore too often unable to perceive the sophistry of plausible schemes, which, when they come to be examined and tested, are readily seen to possess little or no merit.

There is perhaps nothing that is so generally misunderstood as the term profit. Many will think that the difference of about $6 per ton between the price paid for coal by poor people buying by the basket and those who buy by the ton is all profit, for which no service is rendered in return; and yet when the matter is examined it will be found that a large part of this is really wages, and is paid for the labor devoted to handling the coal in small lots and looking after a multitude of small transactions. A coal dealer sitting in his office can as quickly sell ten tons of coal as the small storekeeper can sell a basketful; and since both must be supported by such transactions the cost per ton must be higher where fifty sales must be made to the ton than where one sale is made to ten tons; and this would be so if the city of Boston should go into the business, the same as now.

In commercial transactions, as well as in manufacturing, the lowest cost can only be secured by doing things on a large scale, and to do them on a small scale means increased cost for wages as well as increased total profits paid by consumers.

We have many tenement-house stores here in New York City in which coal is sold by the basketful at about $14 per ton, the storekeeper paying the regular price at which anybody can purchase it by the ton. All other supplies are sold in correspondingly small parcels and at correspondingly high prices, *i. e.*, from two to ten times the price paid for goods of better quality by those better able to pay.

But these stores enjoy no monopoly whatever, and in fact there is usually quite a fierce competition among them, and their proprietors are, in the main, scarcely better off than the people to whom they sell. In other words, after their rent and other expenses are paid, they get rather poor wages for the service performed by them. We will admit that this is a state of things which should be improved, and which will be some day, when people get to thinking down to the bottom of social problems, and social science has advanced in something like the proportion in which manufacturing and industrial occupations have.

The poor pay much higher rents proportionately than those better off. If rent would be increased or the lowest wages decreased in Boston by reason of the crowding and competition of the very poor, resulting from superior attractions there in the way of cheap fuel, it is difficult to see how they would be any better off, and whether or not this would be the effect of cheap or free coal is worth thinking about.

We do not propose to discuss this question, and our object in referring to the matter originally, was to show that municipal coal yards involved a totally different principle from that involved in municipal ownership of water-works and gas-works, etc.

Electricians occasionally complain of the treatment accorded by mechanical engineers to the science of electricity, thinking, evidently, that conservatism, or perhaps prejudice, prevents them from giving to electricity credit for what it is doing, and is capable of doing. While we are not prepared to say that there is absolutely no ground for this charge, we candidly think that much of the apparent indifference of engineers, and their failure to "enthuse" over the claims of electricity as a motive power, or rather as a means of transmission of power, is due to the mistakes made by the special friends of electricity.

A recent instance of this occurs in the publication of an article on an electric crane, which appears in the current number of one of the leading electrical papers. The crane was built by William Sellers & Co., for the Baldwin shops, and its electrical machinery was put in by the Equitable Engineering and Construction Company, of Philadelphia. It is of the overhead traveling type, of 100 tons nominal capacity, and a picture is given showing one of Vauclain's compound locomotives suspended from it. Little description is given that really tells anything, but the article closes as follows: "This is the largest electric traveling crane plant in the world, and presents an impressive evidence of the power of electricity." Now any one at all familiar with the science of mechanics knows that it does not present evidence of any kind as to the power of electricity, and electricity will be in a fair way to be better appreciated when statements of this nature in its behalf are carefully avoided. Every intelligent person ought to know that a one horse-power electric motor would lift 100 tons with properly arranged machinery, and given sufficient time; but this would be no evidence of the power of electricity, because a one horse-power steam engine, or a one horse-power water-wheel, or a one horse-power anything would do the same thing in the same time.

The fact that electricity has been employed in this instance is presumptive evidence that it has some advantages for that

particular place over any other means of transmission, but it proves nothing whatever as to its "power," as compared with other forms of power.

Literary Notes.

The "Supplement" to *The National Car and Locomotive Builder*, which has recently been issued, is as complete and as useful to those interested in the management of railroads as its predecessors have been, which, it may be added, is saying a good deal. It is true that the "Supplement" consists mainly of advertisements, but these are so complete in the lines connected with railroad interests, as to make the book a directory of manufactures, which, with its index, can be used to advantage in the offices of railroad men and manufacturers. In addition, it contains classified lists of various manufacturers, which will be found very convenient in many ways.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(425) W. E., North Tarrytown, N. Y., writes: Please inform me who built the steam yacht "Norwood." *A.*—She was built by C. D. Mosher, Amesbury, Mass.

(426) J. M. H., Baltimore, Md., writes: Please inform me what you consider to be the latest and best work on marine architecture, and iron ship construction. I would prefer something elementary. *A.*—Some of the works published by John Weale, London, are very good. A Manual of Naval Architecture, by W. H. White, F. R. S., is very useful, although it does not treat on iron shipbuilding in particular; it treats on general principles, which should be studied. This is one of the latest books published, and is considered to be a standard work. The best way is to send to any dealer in scientific works for a catalogue, make such selections as may seem to suit you, and examine the works in a public library before you make a purchase.

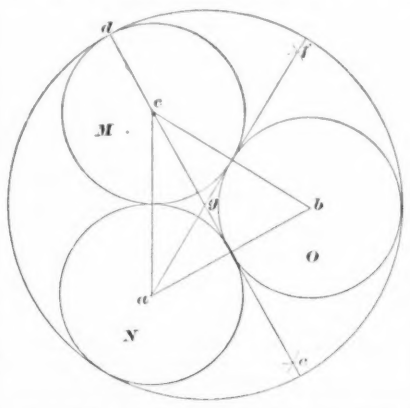
(427) A. J. K., Brooklyn, N. Y., asks: In heating a three-story building, can I make use of the exhaust from a 25 horse-power engine to advantage? *A.*—Yes. 2. Will heaters of one-inch pipe offer too much back pressure? About 1,400 feet of pipe is to be used. *A.*—No; provided the aggregate cross-sectional area of the pipes in the heaters is properly proportioned. 3. In taking steam from the boiler through heaters, can I return the same to boiler without using a trap? *A.*—No, unless you use a pump or injector. 4. What horse-power from the boiler will be used to heat through 1,400 feet of pipe? *A.*—That will depend on the kind of building to be heated, and how it is exposed. See Steam Heating for Buildings, by W. J. Baldwin, M. E.

(428) G. M., Baltimore, Md., writes: Kindly inform me how to get the area of a piston. *A.*—When the stroke of piston, number of strokes per minute, and mean effective steam pressure and required power are known, the area of the piston is found by the following formula:

$$A = \frac{H \times 33{,}000}{P \times L \times N}$$

in which A denotes the area of the piston in square inches; H, the indicated horse-power; L, the length of stroke in feet, and N the number of strokes per minute. In this computation no allowance has been made for the area taken up by the piston rod; the usual practice is to add one half the area of the piston to the area found as above, and then compute the corresponding diameter of the cylinder. 2. Please give the simplest way of finding the area of the steam and exhaust ports for any ordinary slide valve engine. *A.*—See article relating to proportions of steam ports and D slide valves, in our issue of May 1, 1890.

(429) X. Y., Paterson, N. J., writes: Please give the graphical construction for finding the center and radius of a circle which will circumscribe three smaller circles of equal diameter touching each other. *A.*—Let M, N, O be the given circles of equal diameter touching each other. Join their centers a, b and c by straight lines; these will form an equilateral triangle. Bisect any side of this triangle, say $a\,b$, by a perpendicular $d\,e$, cutting the circumference of M in the point d. Again bisect any other side of the triangle, say $b\,c$, by a perpendicular $a\,f$, cutting $d\,e$ in the point g. This



point g will be the center of the circumscribing circle, and $g\,d$ will be its radius. In a similar way the center may be found of a circle circumscribing any three given circles of equal diameters, whether they touch each other or not.

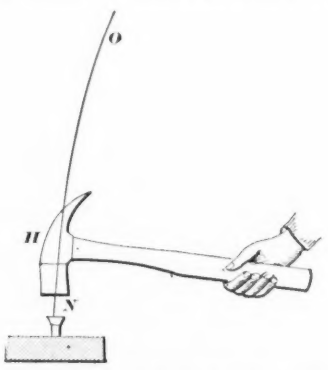
(430) R. B., Mobile, Ala., writes: Please explain the way to set a cut off valve eccentric. Is it not set exactly opposite the crank? I want to know how to set it, say to cut off at ¾ stroke. *A.*—The position of the cut-off eccentric will depend on the kind of valve used. In the Meyer valve gear the cut-off valve rod contains a right and left-handed screw upon which two cut-off valves are threaded. The valve rod has a hand-wheel upon it, and its connection with the eccentric rod is such as to permit its being rotated at will by means of the hand-wheel. This rotation increases or decreases the distance apart of the valves, and thereby changes their lap and the point of cutting off. Engines having this kind of valve gear, and which are to turn in either direction, for instance, such as marine and hoisting engines, have the cut-off eccentric placed exactly opposite the crank, because in this position it is correct for both forward and backward rotation. In stationary engines, turning only in one direction, the cut off eccentric is not usually placed so far in advance of the main eccentric. A common location is 45 degrees in advance. The effect of this is to require a smaller movement for a given change of the expansion; but, on the other hand, it reduces somewhat the width of the port opening given by the cut-off valve, and the speed of cutting off. Hence, in engines of this kind the eccentric must be set to the position indicated on the drawing, and the required point of cut-off is obtained by setting the valves at the proper distance apart by turning the hand-wheel on the cut-off valve rod.

(431) J. G. R., Jeffersonville, Ind., writes: Kindly give me through your columns a solution of the following problem. We have a screw with a fly wheel on one end, and a nut on the other; the wheel is 3 feet diameter, and the crank is 2½ feet long. At the crank-pin ¼ horse power is expended; how much force will the nut exert? *A.*—The force which the nut can exert will depend on the pitch of the screw, which we shall assume to be one inch; it will also depend on the speed of the crank-pin, because in this problem the horse-power expended is given, and this always involves an element of time. During one turn of the screw the crank-pin travels through a distance equal to the circumference of a circle 5 feet diameter, which is equal to 15.7 feet. If, now, the screw makes one turn per minute, and remembering that ¼ of a horse-power is equal to $\frac{33{,}000}{4} = 8{,}250$ foot-pounds of work per minute, we have $\frac{8{,}250}{15.7} = 525.47$ pounds for the force applied at the crank-pin. About 65 to 70 per cent. of this force is required to overcome friction, say 70 per cent.; hence the force required to overcome friction will be $525.47 \times .70 = 367.82$ pounds, leaving an available force for useful work equal to $525.47 - 367.82 = 157.65$ pounds. Now the force exerted by the nut will be as much greater than that on the crank-pin as the path of the crank-pin is greater than the pitch of the screw. The path of the crank-pin we know to be equal to 15.7 feet, and the pitch is equal to $\frac{1}{12}$ of a foot, hence the force exerted by the nut will be $15.7 \div \frac{1}{12} = 188.4$ times greater than that at the crank-pin. Hence, when the screw makes one revolution per minute the force exerted by the screw will be $157.65 \times 188.4 = 29{,}701.26$ pounds. If the screw makes 30 turns per minute, the force exerted by the screw will be 30 times less than that found above, because in every case the power of the nut is always equal to that expended at the crank, less the power required to overcome friction, and therefore as the speed of the nut increases its force will decrease. 2. What kind of screw works the easiest and most exact? *A.*—We should use a square-threaded screw.

(432) W. M., Buda, Ill., writes: Please give me a rule for computing the force of a falling weight, such as a pile driver, etc. *A.*—The force of a falling weight is computed from the formula $m\,v = f\,t$, in which m denotes the mass of the body, which is numerically equal to the weight of the body divided by 32.2; v denotes the velocity in feet per second at the end of the fall of the body; f the mean force of the blow, and t the time or duration of the blow in seconds. The product of $m\,v$ is called the momentum; and the product $f\,t$ the impulse. From the foregoing formula we get:

$$f = \frac{m\,v}{t} \qquad (2)$$

Which means that the force of the blow is numerically equal to the momentum divided by the time of the blow. To illustrate: a ram weighing 8,050 pounds falls through a height of six feet; the duration of the blow is ¼ of a second. What is the average force of the blow? Here the mass is equal to $\frac{8{,}050}{32.2} = 250$. The velocity at the end of the fall is found by multiplying 64.4 by the



height in feet through which the ram falls, and then finding the square root of the product. Hence we have for the velocity $v = \sqrt{64.4 \times 6} = 19.6$ feet. Substituting these values for the symbols in formula (2) we have: $f = \frac{250 \times 19.6}{.25} = 19{,}600$ pounds for the mean force of the blow. Take another example: A hammer H (see figure) strikes a nail N, and drives it ¼ of an inch; the hammer weighs 8.05 pounds, and in delivering the blow it passes over the space $O\,N = 5$ feet in a second; find the force in pounds delivered by the hammer upon the head of the nail. The time occupied in driving the nail ¼ of an inch cannot be less than $\frac{1}{240}$ of a second, because 5 feet : $\frac{1}{4}$ foot :: one second : $\frac{1}{240}$ second. Therefore the value of t in formula (2) is $\frac{1}{240}$ second; the mass $m = \frac{8.05}{32.2} = .25$; and $v = 5$ feet. Now substituting these values for the symbols in formula (2) we have: $f = \frac{.25 \times 5}{\frac{1}{240}} = .25 \times 5 \times 240 = 300$ pounds for the blow on the head of nail.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 30.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Ice and Refrigerating Machines, 170 sold, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 112 Liberty St., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Locomotive Driving-Box Planer Tool. Pedrick & Ayer, Philadelphia, Pa.

Special Tools for Railway Repair Shops. Pedrick & Ayer, Philadelphia, Pa.

Our Automatic Gear Cutting Machine will increase production 50%. The Superior Mach. Wks., Clev'd, O.

Boston Gear Works, Boston, Mass. Gear cutting of every description; noiseless gears a specialty.

$13.00 I. Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

Miller's Falls Co., 93 Reade St., New York, are building a Power Frame for their Star Hack Saw.

S. A. Smith, 23 So. Canal St., Chicago, Ill., agent for Appleton Mfg. Co.'s Emery Grinding Machinery.

Save small iron from foundry refuse. It pays. Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.

"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

Most sensitive and durable Damper Regulator made; works within one pound. Send for circular. T. Kieley, 11 W. Thirteenth St., New York.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Self-adjusting Hand-Screw for Pattern and Cabinet Makers, Wood Workers, etc. Sample by mail for 50 cents. Wm. H. Denney, Lancaster, Pa.

Valuable Books for Machinists and Engineers. Send for complete Catalogue to Norman W. Henley & Co., 150 Nassau Street, New York.

Hyd. press, hyd. jacks, steam tables, accumulators, cutting and stamping dies for sheet metal, foot press, etc. S. Hartley, 245 N. J. R. R. Ave., Newark, N. J.

The Corliss Engine, by John T. Henthorn: A Manual especially adapted for every-day use. $1, free by mail. Egbert P. Watson & Son, 150 Nassau street, New York.

25″ / 32″ / 37″ / 42″ — "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

Complete treatise on Screws and Screw-making, with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N. Spon, 12 Cortlandt Street, New York.

Do you wish to become an expert engineer? Hawkins' Hand Book of Calculations will greatly aid you. 10 parts, 25 cents each, or in 1 volume, $2.50. Catalogue. Theo. Audel & Co., Publishers, 91 Liberty St., New York.

De Lamater Screw Propeiler Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Progressive Examinations of Locomotive Engineers and Firemen," by John A. Hill, editor of *The Locomotive Engineer*, is a new pocket edition of a practical work for locomotive enginemen, by a man with ten years of foot-board experience. Nearly 600 questions and answers, colored plates showing position and color of all signals carried. Price, 50 cents. John A. Hill, Box 1736, New York.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES.

An ice factory will probably be erected at Dublin, Ga.

Carter Bros., Dublin, Ga., will enlarge their brass and iron works.

The Montgomery (Ala.) Iron Works are reported as being enlarged.

W. T. Keefe is reported as to erect an ice factory at Thomasville, Ga.

It is stated that a fertilizer factory will be established at Lake City, Fla.

There is a movement on foot in Middlesborough Ky., to locate boiler works there.

Frank Lyman, it is said, contemplates the erection of an iron furnace at Covington, Va.

Graham & Eddins will erect and operate a foundry and machine shop at Gainesville, Fla.

The Mayo Knitting Machine Company, of Franklin, N. H., are building an addition to their works.

The $100,000 oil-mill that is being built at Demopolis, Ala., will be ready for business in October.

An ice factory, with a daily capacity of twenty five tons, will be built at Columbus, Ga., by A. Ellis & Co.

The machine shops of the Seaboard Air Line, at Raleigh, N. C., will probably be moved to Monroe, N. C.

The United States Rolling Stock Company, of Decatur, Ala., has resumed work, with a full corps of men.

Fertilizer works are to be established at Camden Ark., by the Memphis Fertilizer Company, of Memphis, Tenn.

The American Arms Company, of Boston, Mass., manufacturers of fine arms, intend removing to Bluffton, Ala.

It is stated that the Franklin Brass Works at Buchanan, Va., recently destroyed by fire, will be rebuilt at once.

A co-operative foundry association and an architectural iron works plant have been recently established at Covington, Ky.

The common council of Saginaw, Mich., has decided to issue bonds to the amount of $200,000 for the erection of two bridges.

The East and West Rome Street Railway Company, Rome, Ga., contemplates the erection of an electric light and power plant.

The Smith & Briggs Brass Works have been incorporated at Buchanan, Va., with $50,000 capital, to manufacture brass and iron.

The New Decatur (Ala.) Car Works have resumed operations. They employ about 100 men, but will increase their force later to 200.

It is reported that John Chipman will probably erect a $50,000 plant for the purpose of developing phosphate mines at Louraville, Fla.

Benjamin Haugh will erect works at Louisville, Ky., for the manufacture of a railroad car wheel, for which he has received a patent.

It is reported that the Ludlow valve plant, at Troy, N. Y., has gone into the hands of an English syndicate, the consideration being $900,000.

The Etna Iron Works, at Norfolk, Va., which were destroyed by fire some weeks ago, will be shortly rebuilt with all the latest improvements.

The Shendun (Va.) Machine and Repair Shop has been chartered, with $25,000 capital, to make machinery, operate an iron and brass foundry, etc.

Work on a hammer shop, a producer house and a boiler house to be added to the Boies Steel Car Wheel Co.'s Works, at Scranton, has been begun.

The American Car Co., of St. Paul, Minn., has been incorporated by W. Ruttom, Emil Alexander, T. Papin, Jr., with a capital stock of $100,000.

S. T. Williams, of 447 North street, Baltimore Md., is endeavoring to organize a stock company, for the purpose of manufacturing his steam engine.

The United States Phosphate Company is erecting a phosphate plant at Ft. Meade, Fla. It will have a daily capacity of 100 tons, and will cost $25,000.

Albert Pearre, John Waters, J. S. Boyd and others have incorporated the Southern Electric Co., at Baltimore, Md., with a capital stock of $50,000.

The Western Foundry Company has been organized at Covington, Ky., James Tully, president, to operate a foundry for making large and small castings.

There are some rumors that a steel plant is to be commenced at Goshen, Va., at an early date. It is stated that the parties interested are Baltimore capitalists.

International Electric Manufacturing Co., of Chicago, has been incorporated; capital, $100,000; incorporators, J. S. Fifield, E. T. Brainard, and T. E. Rushbrook.

The Wormer Machine Co., St. Louis, has been incorporated; capital, $3,000. The stockholders are Theo. K. Wormer, Alfred M. Shepard, and Frank Hargeusleker.

The Aluminum Mining and Smelting Company has been formed at Chicago, Ill.; capital, $1,000,000. Incorporators, Freeman Lane, S. D. Ovitt and M. Walker.

A new management, it is said, will shortly take hold of the South Tredegar Iron Works, at Chattanooga, Tenn., and several improvements will be made in the plant.

The Chattanooga Foundry and Pipe Works, of Chattanooga, Tenn., has completed its branch pipe works at Bridgeport, Ala. The plant has a daily capacity of 100 tons.

The Florence (S. C.) iron works have begun business in temporary quarters. Their permanent building is being erected near the line of the Wilmington Railroad.

Henry M. Mann, of Chicago, Ill., is reported as having purchased 470 acres of phosphate land near Sydney, Fla., for $23,000, and as to erect a plant for the development of same.

Louis E. Lemarie and associates have had introduced in the city council (New Orleans, La.,) an ordinance granting them authority to erect electric light and power plant, etc.

The Gray Electric Co. has bought fifty acres of land in Highland Park, near Chicago, and will build works for the manufacture of electrical appliances, as well as dwellings for employes.

The Howard Harrison Iron Company, of Bessemer, Ala., has contract for the iron piping for the Savannah (Ga.) Water-works at $21.75 per ton, and $55 per ton for the special castings.

Work was begun on the new shop to be built at Florence, Mass., for the Ulrich Engine Company. The building will take about 300,000 brick. It will be ready for occupancy by December.

The can factory of J. H. Pocock, at St. Louis, Mo., which was destroyed by fire a few weeks ago, is to be rebuilt. The ruins are being cleared away, and the work of rebuilding will begin at once.

H. T. Cooper, Douglasville, Ga., will receive bids until September 19 for the construction of a bridge across Dog River at Watkins' Mill. Plans and specifications can be seen on application.

The Terracea Phosphate Company, recently incorporated, to develop phosphate mines, will at once erect a 200-ton phosphate plant on its 400-acre tract of phosphate land near Bartow, Fla.

The Rockingham Combination Slat and Wire Fence Machine Co. has been incorporated at Harrisonburg, Va., to manufacture and deal in slat and wire fence machines; capital stock, $50,000.

The Walworth Manufacturing Co.'s old foundry at Cambridge, Mass., is being remodeled and enlarged, and will be let for manufacturing purposes. It will probably be completed some time in September.

The Briggs Rolling-mill Company, of Findlay, O., will erect a muck mill and merchants' department building at the junction of the Lake Erie & Toledo Railroad, to be 280x300 feet, two stories, and to cost $10,000.

The Peoria Fence Co., Peoria, Ill., was organized on the 19th inst., for the purpose of manufacturing and selling a combination wire and iron fence. Frank Garthuvit and Martin V. B. Cumetford are the incorporators.

Mr. Josiah Holmes, of Cumberland, Md., will start at once the erection of a machine shop, which will be the nucleus of a rolling-mill he intends to erect. The rolls have already been ordered and also a large amount of machinery.

The Newnan (Ga.) Light and Power Company has closed contracts for an Edison plant with capacity for 600 incandescent and 40 arc lights. The company has a 15-year contract to light the city at not less than $2,800 per year.

The Buffalo Drop Forge Company have applied for a certificate of incorporation, to manufacture and sell drop forgings, tools and machinery; capital, $40,000; directors: Samuel C. Rogers, Geo. D. Barr, Robt. T. Walker, and others.

The Rollason Gas Engine Co., 134 Liberty street, New York, has issued a catalogue illustrating and describing this engine in the various forms in which it is manufactured. The illustrations are good, and the printed matter is in good taste.

The new factory of the Maryland Tack Company, at Front Royal, Va., has been occupied, and the company has increased its facilities in every way, one feature being the addition of forty new machines to the plant, making seventy in all.

M. Twillier, representing several French companies, has purchased for about $200,000 the phosphate properties of the Peninsular Phosphate Company. The property includes 1,000 acres of land and phosphate plants at Sparr and Anthony, Fla.

Work at the Talladega (Ala.) Iron & Steel Company's works has been suspended for a few months, on account of its financial condition. It is thought it will be only a short while before they resume work. Joseph A. Edwards was appointed receiver.

M. N. Coe, Edward de Never, T. H. Roberts and others have incorporated the Coe Manufacturing Company, Limited, at New Orleans, La., for the manufacture of the Coe automatic rain-water cut-offs, gutter piping, cisterns, etc. The capital stock is $100,000.

C. T. N. Engles, J. W. Forrest, T. L. Bird and others have incorporated the Electric File Renovating Co., to sell rights for the utilization of the electric process of renovating files, to establish factory, etc., at Middlesborough, Ky. The capital stock is $16,000.

Wallace, Banfield & Co., of Irondale, O., are having built a complete tin-plate plant, including 22-inch tin-plate mills, double shears, trimming shears, annealing furnace, picking machines, and all machinery and castings required in fitting up six tinning tanks.

James A. Chambers, Pittsburgh, Pa., is seeking a site for a new glass plant that will be the largest window-glass factory in the world. He has associated with him some wealthy men. He has been up the Monongahela valley to view some sites that had been suggested.

The State Construction Company, of Chicago, has been formed, to manufacture and deal in rolling-stock and machinery for street railways, and to build street railways; capital stock, $1,000,000; incorporators, Houston C. Adcock, Nathan G. Moore and Edward P. Town.

The Duechting-McCray Refrigerator Car Company, of Chicago, has been incorporated by Anderson Fowler, Robert Clegg and William Duechting, with capital stock of $50,000. The company is formed for the manufacture, sale and operation of refrigerating apparatus for cars.

The Branch Tool Manufacturing Company, of Indianapolis, Ind., has been formed, for the manufacture of machinery, tools, furnishing motive power for manufacturing same, etc. William E. Duthie, William H. Daggett and Frank B. Fowler are the directors of the company.

The D. & D. Electric Manufacturing Company, of Minneapolis, Minn., has been organized, with a capital of $50,000. It will manufacture and sell electric motors, dynamos and other electric appliances. Gilbert Donaldson and Thos. Davis, of St. Paul, and Frederick G. James, of Minneapolis, are the promoters.

Ground has been broken for the new works of the Wilkes Rolling-mill Company, of Sharon, Pa. Two buildings will be erected, one 60x64 for the engine and rolls, and the other 36x160 for the puddling department. Some of the machinery is now on the ground, and it is expected it will be in operation in three or four months.

The Lake Erie Construction Company has been incorporated, at Sandusky, Ohio, with capital stock of $20,000. The object of the company is the contracting for the building and equipping of railroads, docks, etc. J. A. Pannabaker, C. L. Gardner, C. N. Wells, D. D. Byers and Fred A. Moore are the interested parties.

The National Car Wheel Company, of Chicago, has been incorporated, with capital stock of $100,000, for the manufacture of car wheels, axles, etc., and to conduct a foundry and manufacturing business. Jas. F. Meagher, A. E. Rawson, F. S. Winston, A. E. Peters, and Lorenzo C. Brooks are the stockholders of the company.

A new company has been organized at Pittsburgh, to be known as the Northwest Ammonia Power Company. The object of the company is to put into active operation the Campbell ammonia power, recently invented by C. H. Campbell, of that city. The idea is to use ammonia gas in the cylinders of engines, instead of steam.

The Duquesne (Pa.) Tube Company's $90,000 addition to its pipe-mill has been completed. This department will employ 200 additional men, and as soon as these men are set to work the company will begin the erection of a large butt-weld-mill In the future this firm will make its own gas from coal, having just completed a large plant.

The Cash Safety Car Company, of Portland, Maine, has been formed for the manufacture of railway gates. Dean Peabody, Geo. H. Chadwell, Francis C. Cash, Joseph W. Harding, Chas. H. Welch and Chas. B. Lord, of Lynn Mass., W. G. Ellis, of Amesbury, Mass., and Edward K. Butler, of Boston, Mass., are the stockholders, the last mentioned being president of the company.

There is water-works agitation in Port Angeles, Wash.; Dayton, O.; Baird, Tex; Concord, N. H; Port Huron, Mich.; Chadron, Neb.; Shelbyville, Ky.; Easthampton, Mass.; Oshkosh, Wis.; Suffolk, Va.; Rockville, Conn.; Detroit, Mich.; Seattle, Wash.; Cleveland, O.; St. Joseph, Mich.; Gaffney City, S. C.; Hondo City, Tex.; Macon, Ga.; Santa Fe, N. M.; Gainesville, Tex.; South Bend, Wash.

The plans for the new plant of the Norwood Car Replacer Company, at Lambert's Point, near Norfolk, Va., include two buildings, the foundry being 100x200 feet, one-story high, with room for seventy-eight molders. The other building, 100x150 feet, will contain pattern-room, core-room, annealing furnaces, shipping room, offices, etc. The company will have excellent shipping facilities, both by rail and by water.

The Elektron Company, Springfield, Mass., already has forty men at work. New machinery is being received constantly, and matters are fast assuming definite shape. The lower floor is devoted to the machine work, the second floor to the assembling and testing, and the top story to the winding. The company manufactures motors from one-twelfth to 20 horse-power, and dynamos of as high capacity as 250 lights.

The Genett Air-brake Company, of Chicago, has been incorporated, with capital stock of $800,000, The company intends to manufacture and sell the Genett patent air-brake and Genett's patents, present and prospective, and license others to operate the same. The following are the stockholders: Louis J. Genett, Isaac Neuberger, Moses L. Rothschild, D. Wallach, Jacob Rothschild, Philip Opper and Moses L. Rothschild.

Parallel Motions.

BY PROF. A. MACLAY, GLASGOW, SCOTLAND.

THIRD PAPER.

(5)—STRAIGHT LINE MOTIONS.

In these mechanisms the object is to cause some one point on them to move in a line exactly or very approximately straight, without the direct use of sliding pairs or plane surface guides; and in a parallel motion or pantographic application of the foregoing, the object is to cause one or more points to copy this path with a greater or less range of motion. There are two classes of straight line motions; first, those in which the path is only approximately straight; and second, those in which it is exactly so. The former class was introduced by James Watt about 1784, but the first of the latter was only invented by Peaucellier in 1864. The approximate class is represented by three varieties (*a*) lemniscate, (*b*) elliptical, and (*c*) conchoidal, according to the nature of the complete curve described by the principal guided point. In the exact class two points move in paths which are in the relation of inverse curves. The mechanisms consist of combinations of the two simple varieties of the quadric crank, known as the "kite" and the "spearhead." By placing the parallelogram upon each variety of these mechanisms we get the same number of varieties of parallel motions.

(6)—LEMNISCATE PARALLEL MOTION.

Example 6.—*To draw a Watt parallel motion suitable for application to the piston and air-pump rods of an ordinary beam engine, the lengths of the strokes being given* (5′ 0″ *and* 2′ 0″. *Scale* $\frac{1}{12}$).

Draw first the vertical line $Y\,Y$, Fig. 6, representing the center line of the cylinder and piston rod, and on it mark off $D^1\,D_1 = 5'\,0''$. The front link $C^1\,D^1$ connecting the piston rod head D^1 to the end of the beam $C^1\,A$ is generally made of length equal to the half stroke, but for the sake of clearness in the diagram we will take it longer, say about two-thirds of the length of the stroke. Bisect $D^1\,D_1$ at D. From D on $Y\,Y$ measure off $D\,e = 3'\,4''$. Through e draw a horizontal line $X\,X$. The center line of the beam will be on the line $X\,X$ when it is in its mid-position. At a distance equal to half stroke, and on each side of $X\,X$, draw the parallel lines $a\,a$, $b\,b$, intersecting $Y\,Y$ at c and d. From c or d draw a trial line, at an inclination not exceeding 20°, with the horizontal, intersecting $X\,X$ at x. With x as center radius $x\,c$ or $x\,d$, draw an arc $c\,m\,d$, cutting $X\,X$ at m. Bisect $m\,e$ at C. On $X\,X$ mark off $C\,A = m\,x$. With A as center radius $A\,C$, draw an arc $C^1\,C\,C_1$, intersecting $a\,a$ and $b\,b$ at C^1 and C_1. Join $A\,C^1$ and $A\,C_1$. Then A is the main center of the working beam, $A\,C$ is its radius, $A\,C^1$, $A\,C_1$ its highest and lowest positions respectively.

Next proceed to find the air-pump center B. Divide the line $A\,C$ at B in the proportion $A\,B : A\,C :: 2 : 5$. [Set off any line $C\,g$, and on it mark off $C\,f = 3$ units and $f\,g = 2$ units of any convenient scale. Join $g\,A$ and draw $f\,B$ parallel to it. It is more convenient to set off the line from A rather than from C, but the latter is chosen here to make the figure clearer.] Complete now the parallelogram $C\,D\,E\,B$. The point D as the head of the piston rod is to move in the vertical straight line $Y\,Y$, and it may therefore either be guided in that line, or be connected by the parallelogram $C\,D\,E\,B$ with some point which is guided in a parallel straight line. Join $A\,D$, intersecting $B\,E$ at F. Then F is the center of the air-pump rod head, and if it be guided to move in the straight vertical line $Z\,Z$, D will move in the parallel line $Y\,Y$, with a range of motion $\frac{5}{3}$ times that of F.

Next for the application of the Watt straight line motion. On the line $E\,D$ cut off a length $E\,G$ in the proportion $E\,G : A\,B :: B\,F : F\,E$.

[Thus for example, on $C\,g$ mark off $C\,h = B\,F$, and on $C\,X$ mark off $C\,i = F\,E$ and $C\,k = A\,B$. Join $i\,h$ and draw $k\,j$ parallel to it. Then $C\,j = E\,G$.] Then G is the center of the radius bar, $G\,E$ is its length. The straight line motion consists of the two cranks $A\,B$ and $G\,E$, the coupler $E\,B$ and the fixed link $G\,A$ (representing all the fixtures between these two points.) As such, the complete path of the guided point F is a lemniscoid curve resembling the figure 8, but only that part of the curve which extends a short distance each way from its point of intersection is straight, or approximately so. Hence the limit put upon the range of angular motion of the beam.

It will be evident that the construction given admits of variation in detail. Very often, for example, the stroke of the air-pump bucket is half that of the piston. In this case the construction is simplified. For then $A\,B = B\,C$, $B\,F = F\,E$, and $E\,G = A\,B$.

Complete the exercise by drawing the mechanism in several positions, and showing that the lines $)\,($ and $Z\,Z$ are the loci of the points D and F for the range of motion given.

Example 7.—*Fig.* 7. *To draw a Watt parallel motion as applied to a Woolff engine, having given the strokes* S_1, S_2 and S_3 *of the air-pump and of the inner and outer cylinders.* (Say $S_1 = 2$ feet, $S_2 = 4$ feet, $S_3 = 6$ feet. Scale $\frac{1}{12}$.)

Proceed as in the last example to find the length of the working beam $A\,D$, and the position of its main center A. Then divide the line $A\,D$ at the points B and C, so that

$$A\,B : A\,C : A\,D :: S_1 : S_2 : S_3.$$

Draw $D\,E$ as in Example 6, making $D\,E = \frac{1}{2}\,S_3$, and through C and B draw $C\,F$ and $B\,G$ parallel to $D\,E$, then $E\,F\,G$ parallel to $A\,D$. Join $A\,E$, intersecting $C\,F$ at

J and $B\ G$ at K. If then one of the three points K, J or E be guided in a straight line the others will move in parallel lines with ranges of motion proportional to their distances from the main center A. Let K, the point with the shortest range of motion, be the guided point. Cut off $K\ H = B\ K$, and draw $H\ I$ parallel to $A\ D$, intersecting $A\ E$ at I. Then for the equal segments $B\ K$ and $K\ H$, assumed on the back link, I will be the fixed center of the radius bar $I\ H$.

Draw the complete mechanism in five or six different positions, and show that the paths of the points E, J and K are parallel straight lines, and that the strokes are in the proportion given.

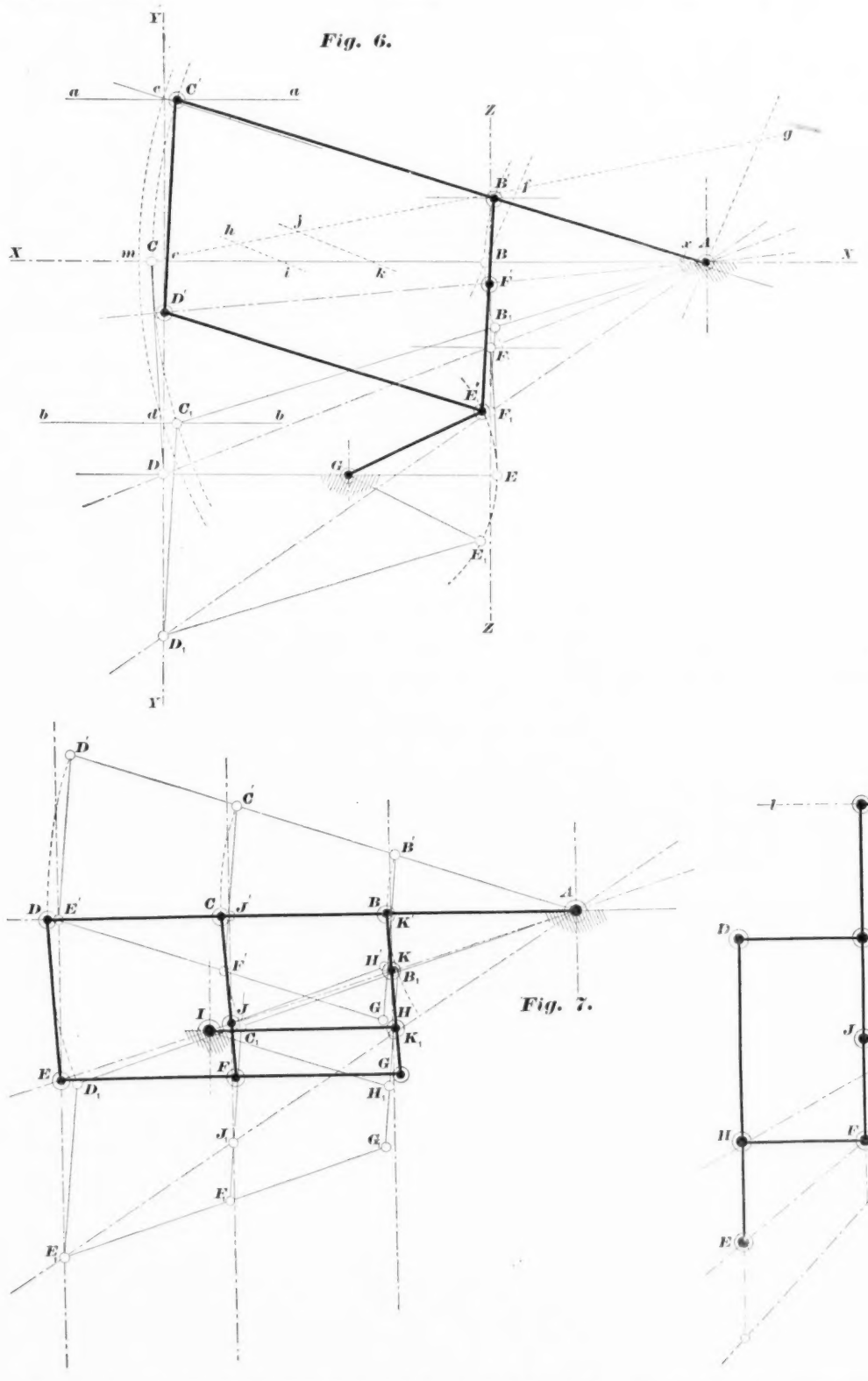


Fig. 6.

Example 8.—*Fig.* 8. *Watt's parallel motion as applied to marine engines of the side lever type.*

Suppose it to be required to have three points moving in vertical straight lines as before, but that it is inconvenient to apply the parallelogram below the working beam, and let the strokes S_1, S_2 and S_3 be in the proportion of $1 : 2 : 3$ (say $S_1 = 2$ feet, $S_2 = 4$ feet and $S_3 = 6$ feet. Scale $\frac{1}{12}$). Apply the instructions given in the last two examples, and obtain the mechanism represented in Fig. 8. A is the main center, $A\ C$ the radius of the beam, $B\ C\ D\ G$ the parallelogram, $I\ G$ the radius bar, H the main guided point, F and E two points which copy its motion, with strokes S_2 and S_3 respectively. Draw the mechanism in several positions, and show the paths of E_1 F and H.

Example 9.—*Fig.* 9. *An example of Watt's parallel motion applied to both ends of working beam.*

$D\ O$ is the working beam of the engine, A its main center, $D\ K\ I\ B$ a parallelogram placed upon the beam at its front end, $L\ I$ a radius bar proportioned in position and length for guiding point H in the back link in a vertical straight line, K, F and N other three points which are to move in parallel straight lines, with strokes of given lengths, say $S_k = 6$ feet : $S_f = 4'\ 6''$: $S_n = 3$ feet : $S_n = 3'\ 6''$. (Scale $\frac{1}{12}$.) To draw the example, proceed as in Example 6 to determine the radius of the beam $A\ D$, and the positions of the centers C, B and O; *i. e.*, make

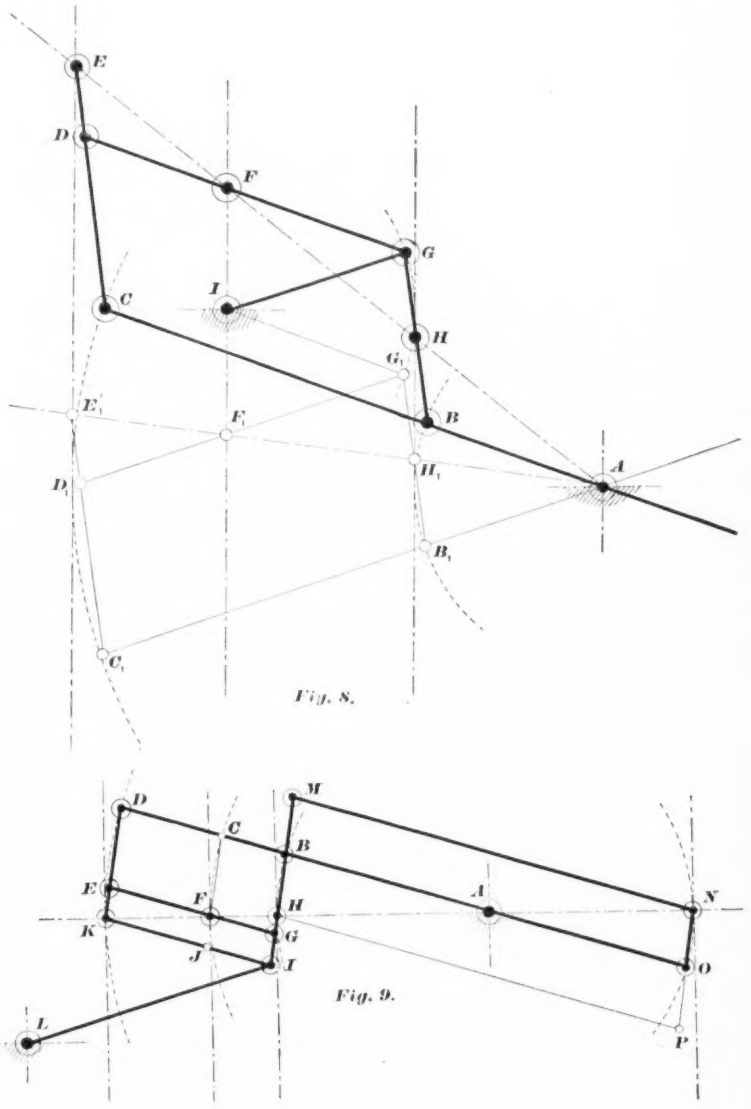


Fig. 8.

Fig. 9.

$A\ B : A\ C : A\ O : A\ D :: S_1 : S_f : S_n : S_k$.

Having drawn $D\ K$, as explained in Example 6, then draw $C\ J$, $B\ I$ and $O\ P$ or $O\ N$ parallel to it. Next draw $K\ I$ and $H\ P$ or $N\ M$ parallel to $D\ O$. The center F may either be placed on a link $C\ J$ parallel to $D\ K$, or on one $E\ G$ parallel to $K\ I$, and the center N may be worked from H, either by $H\ P$ and $P\ O\ N$, or by $H\ B$ prolonged to M, $M\ N$ and $N\ O$, according to convenience.

Next determine a radius bar $I\ L$ of such length that H may move very approximately in a straight vertical line; *i. e.*, cut off a length $I\ L$ such that $I\ L : A\ B :: B\ H : H\ I$. Then L is the fixed center of the radius bar, and $I\ L$ its length. Lastly draw the mechanism in several positions, and show that the joints K, F, H and N move in parallel straight lines with strokes in the required proportion.

Fig. 7.

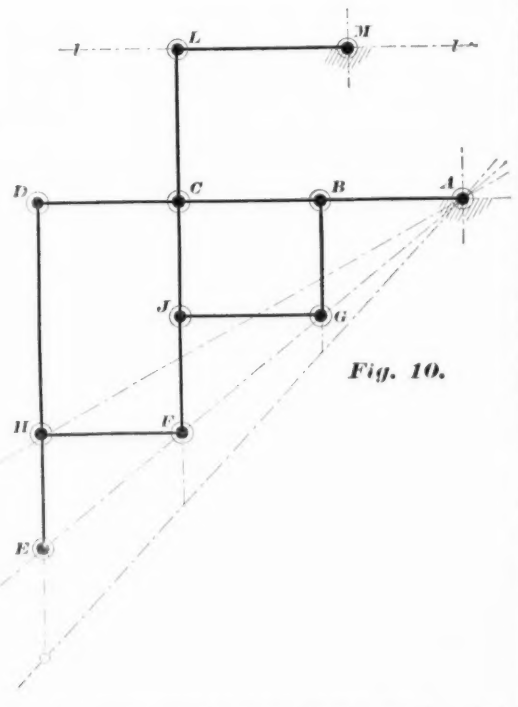


Fig. 10.

Example 10.—*Fig.* 10. *Modification of Watt's parallel motion—Radius bar and guided point on opposite sides of beam.*

Let it be required to have three points moving in straight vertical lines, with strokes represented by given lengths, say $S = 1'\ 7''$: $S_2 = 3'\ 2''$: $S_3 = 4'\ 9''$ (Scale $\frac{1}{16}$). Find the radius of the beam, the position of the main center A, and of the intermediate centers B and C, as in Examples 6 and 7. Draw $D\ E$ as in the figure, and parallels to it through C and B. Then draw $A\ E$, intersecting these parallels at F and G. E, F and G may then be the three points which are to move in parallel straight lines. Through F draw $F\ H$ parallel to $A\ D$, intersecting $D\ E$ at H. Suppose that in this example the point F is the one chosen to be guided in the approximate straight line, and that it is more convenient to center the radius bar above than below the beam, say, for example, at level $l\ l$, $3'\ 3''$ above A, intersecting $F\ C$, produced upwards at L. Then on line $l\ l$, and on the same side of $F\ L$ as the main center A, find a point M at such distance $L\ M$ that $M\ L : A\ C :: C\ F : L\ F$. Then M is the required center of the radius bar, and the joint F will be guided for a range of motion S_2, in an approximately straight line, which G and E will reproduce with ranges of movement proportional to their distances from the main center A.

The Midland Railway Company (England has issued the following:

"Referring to the instructions on page 118 of the Appendix to the working time table, the arrangement which has heretofore been in operation for locking carriage doors on the off side of trains has been discontinued, and the doors on both sides must in future be left unlocked. In case of a train being stopped on the line away from a station, the guard or guards must prevent passengers from alighting on the off side of the train."

Machinists' Supplies and Iron.

NEW YORK, September 26, 1891.

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We quote: Standard Northern brands, No. 1 Foundry, at $16.75 to $18; No. 2 is selling at $15.50 to $16.50, and Gray Forge at $13.90 to $15. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote Coltness at $23, and Eglington at $20.50.

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Lead—The sales do not indicate a steady market and confidence in the near future is not firm. There have been no offerings of spot lead recently, but 4.52½c. will buy. Smelters entertain elevated views on delivery for the balance of the year, and buyers are disposed to operate cautiously.

Spelter—The market is reported as "flat" so far as business is concerned, but former rates are well maintained. Holders are not inclined to accept less than 4.95c. for shipments, and 5c. on spot.

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Wanted—Position as foreman boiler maker by a man of large experience with locomotive, stationary and all kinds of sheet-iron work; best of refs.; 10 years as foreman. Address Box 61, AM. MACH.

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Wanted—A foreman to take charge of floor and machine work for concern manufacturing pumping mach'y. Applicants must state age and past exp. References required. Box 69, AM. MACHINIST.

Mechanical engineer desires a position; have 18 years' experience as machinist, pattern maker, draftsman and marine engineer (British certificates). 8 years last situation as chief draftsman & master mech. 1st-class refs. M. H. E., AM. MACH.

A superintendent, at present in charge of machine screw works, desires similar position in turret machine department, where rapid and accurate work is required, or in shop building screw machines. Address X. Y., AMERICAN MACHINIST.

Wanted—I desire to correspond with Machinery and Tool Manfrs., with a view of taking a New York agency for the sale of their manufactures. Satisfactory references furnished as to experience, etc. Address Box 70, AMERICAN MACHINIST.

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Advertisements will be inserted under this head at 25 cents per line, each insertion.

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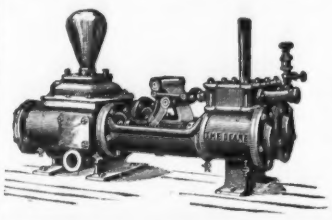

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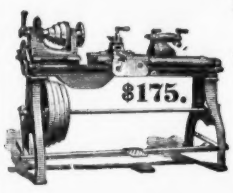

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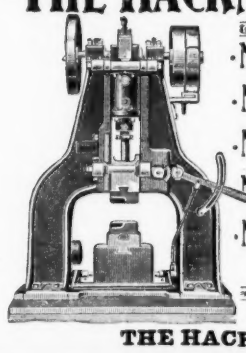

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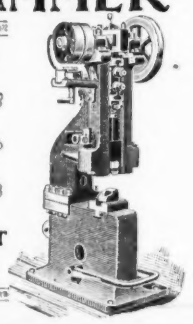

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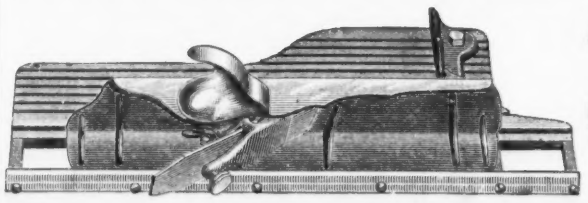

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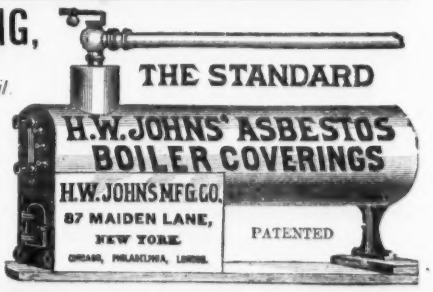

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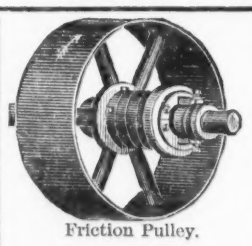

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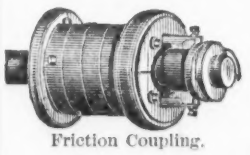

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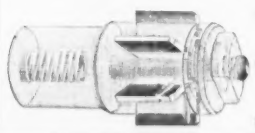

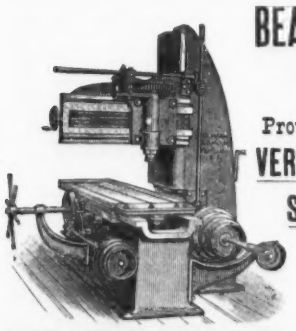

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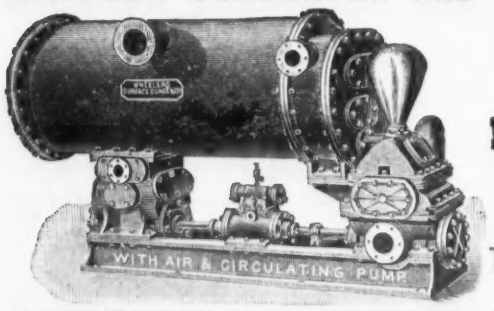

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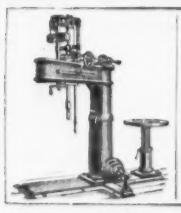

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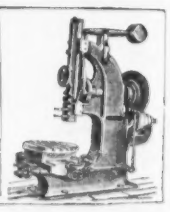

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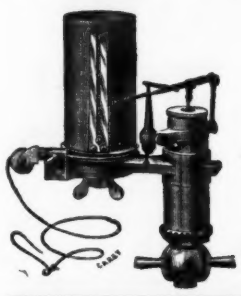

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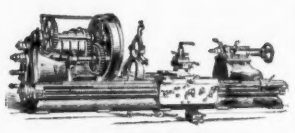

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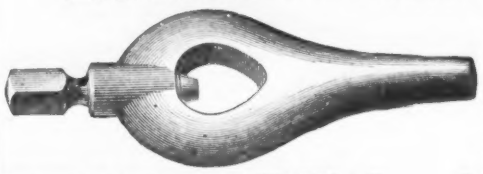

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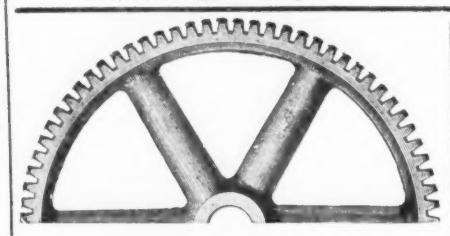

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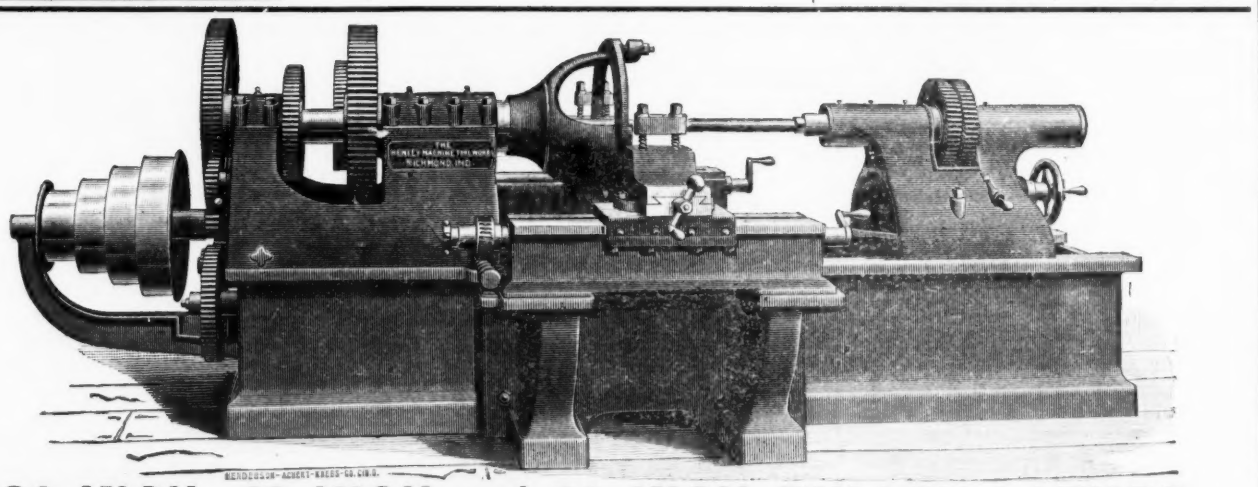

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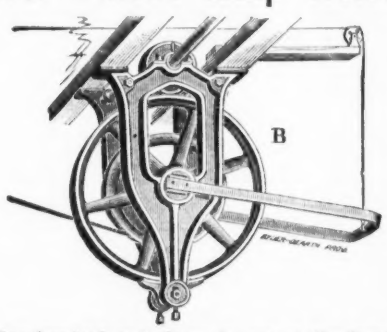

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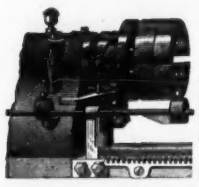

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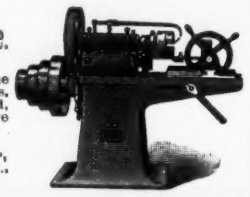

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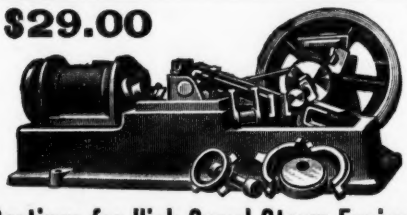

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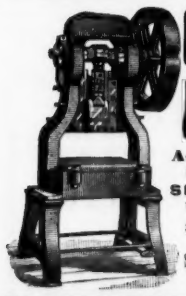

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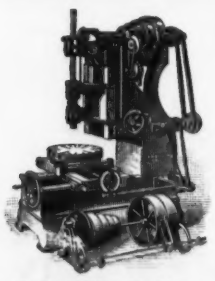

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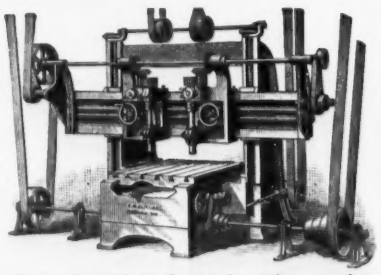

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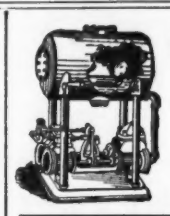

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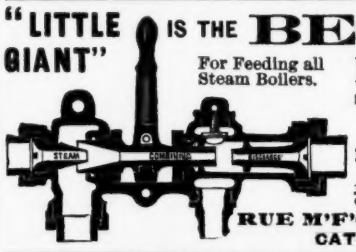

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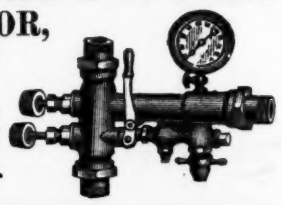

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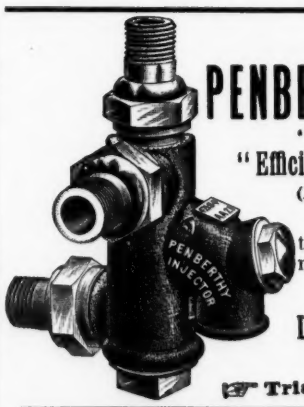

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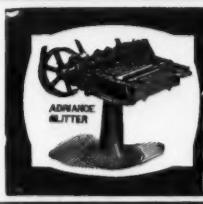

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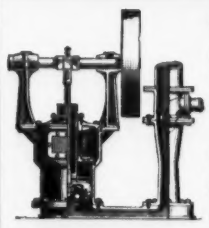

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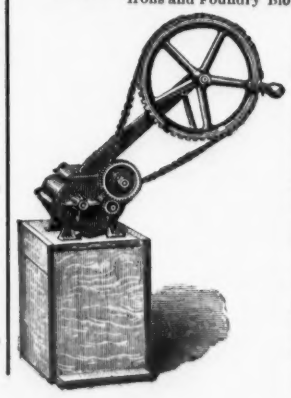

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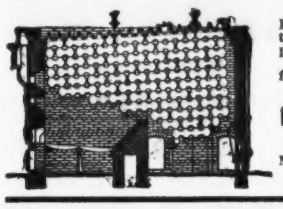

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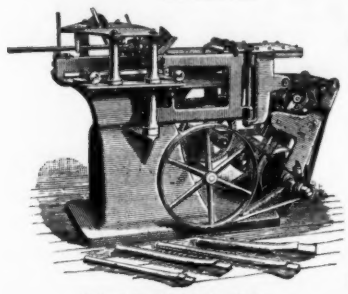

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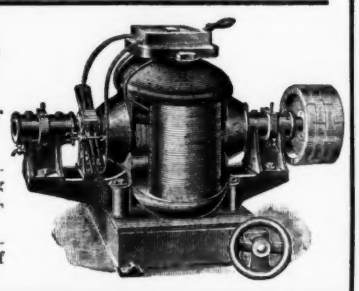

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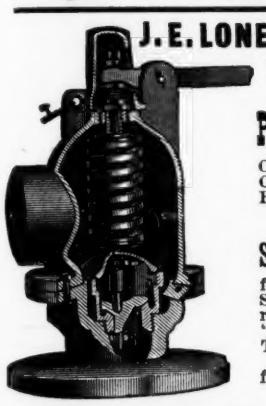

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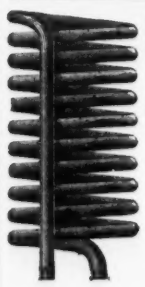

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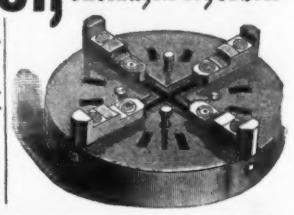

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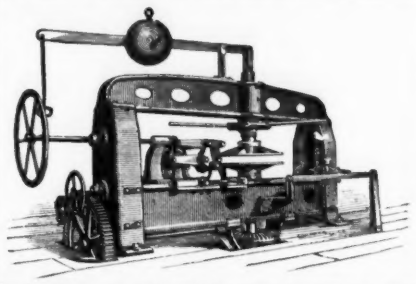

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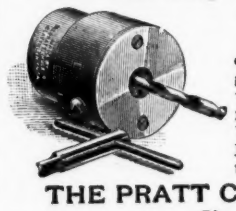

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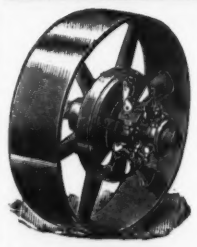

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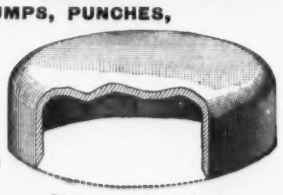

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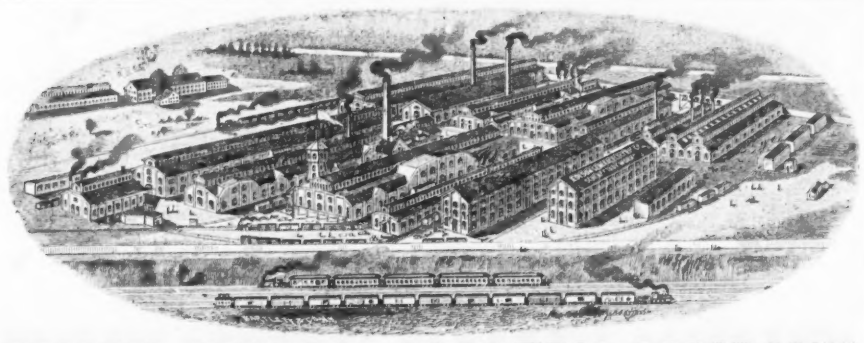

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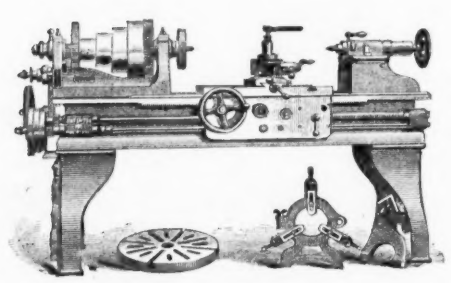

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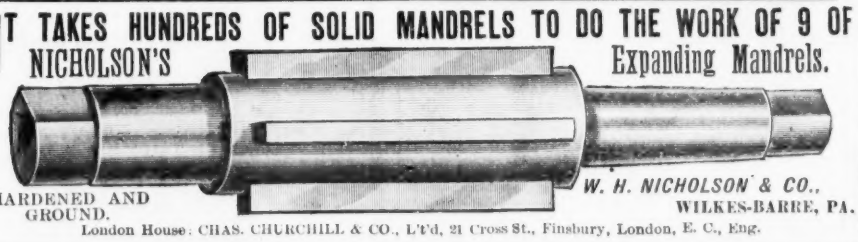

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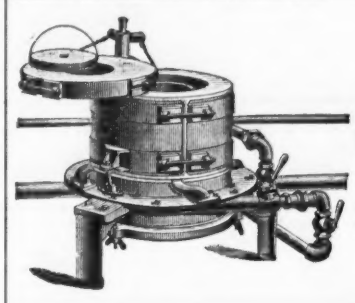

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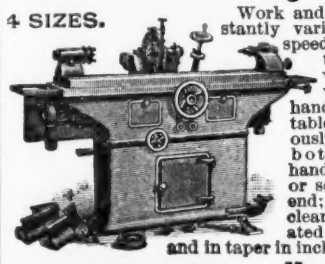

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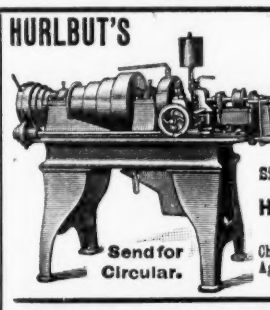

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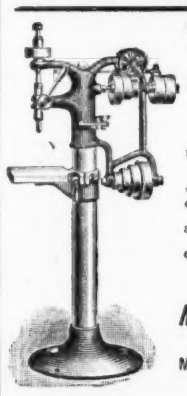

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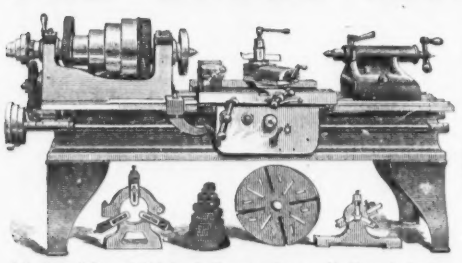

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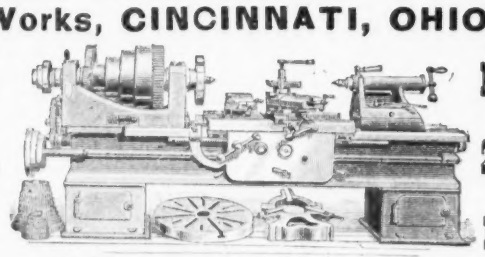

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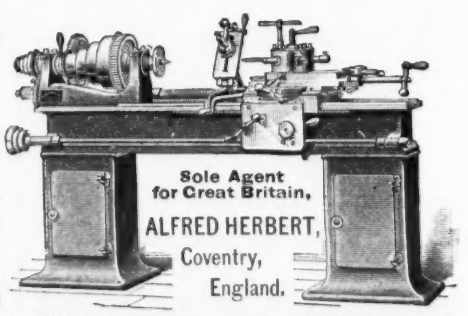

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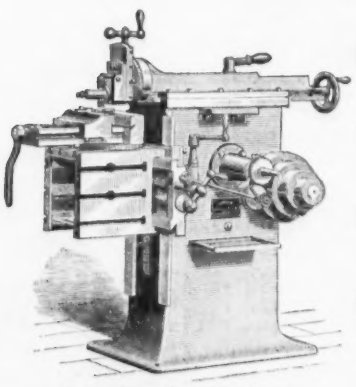

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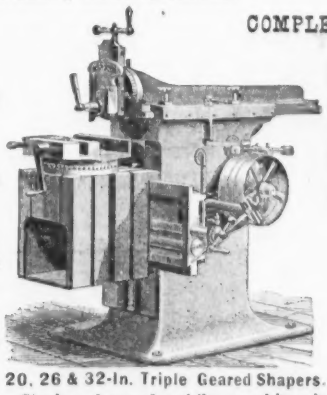

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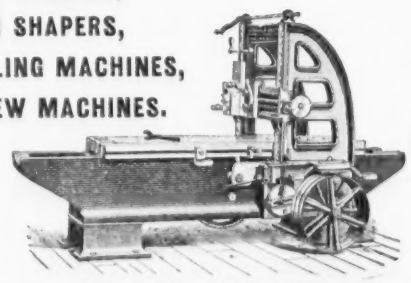

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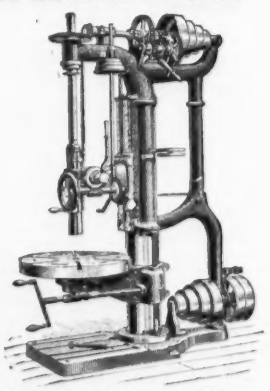

25, 28, 32 and 40-Inch Drills.
Automatic stop to feed. Quick return on right side. Table operated from front. Large cones and long belts.

See Advertisement on Page 20.

MORSE TWIST DRILL AND MACHINE COMPANY,
Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

ENGINE LATHES from 10 to 30 inches swing.
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FLATHER'S NEW PATTERN
22 Inch Engine Lathe,
Has many Original and Valuable Improvements.
HILL, CLARKE & CO.
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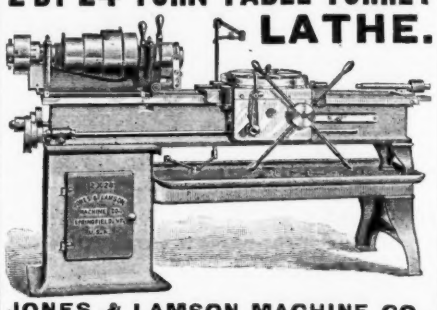

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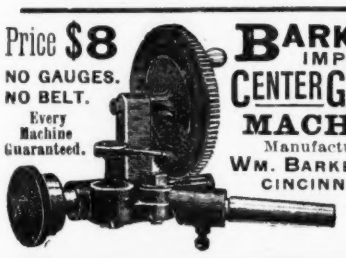
Every Machine Guaranteed.



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Manufacturers of and Dealers in
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IMPROVED PATENT IRON PLANERS A SPECIALTY.
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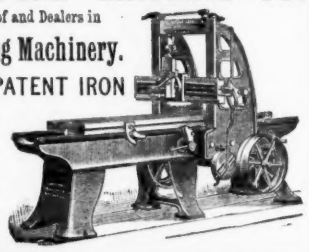

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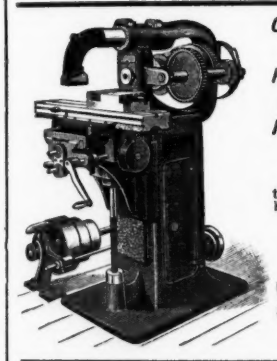

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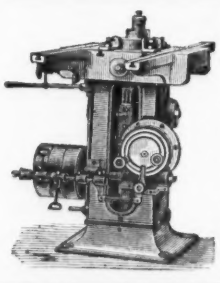

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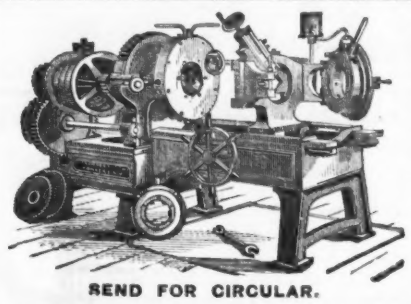

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For Pipe, Mill and Steam Fitters' Use.
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For Steam Fitting, also
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Plain and Universal Milling Machines and Universal Cutter Grinders.
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15 H. P. Erie City Engine.
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Engine in Good Condition (running).
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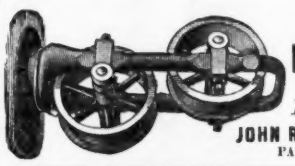

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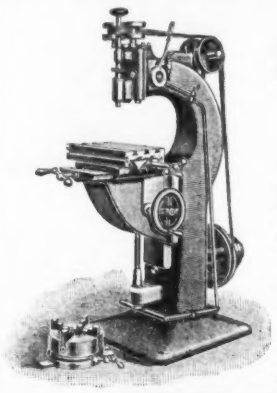

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An indispensable Tool in any well appointed machine shop.
Speeds from 240 to 10,000 revs.
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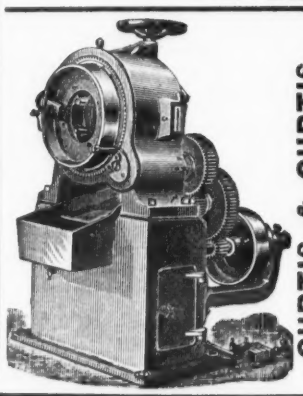

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It will pay you to write us for particulars.
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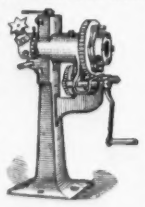

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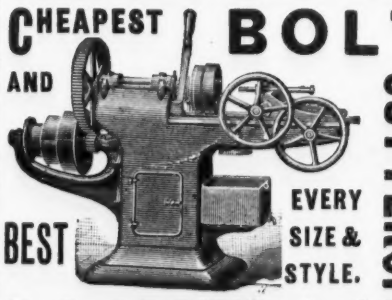

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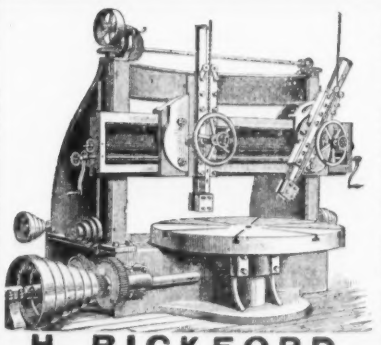

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Nevertheless, this waste occurs daily, when you use a pump governor that wastes, instead of economizing your steam. Our Pump Governor economizes steam, besides causing the pump to maintain a perfectly uniform stroke. A trial, we are sure, will convince you of its merits. Send for a catalogue of our goods.
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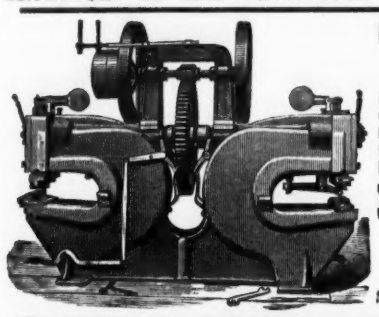

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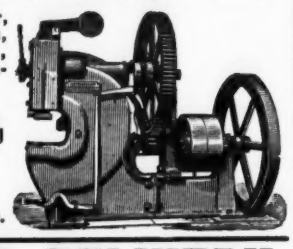

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2 INCH SPINDLE.
Weight, 1100 Lbs.
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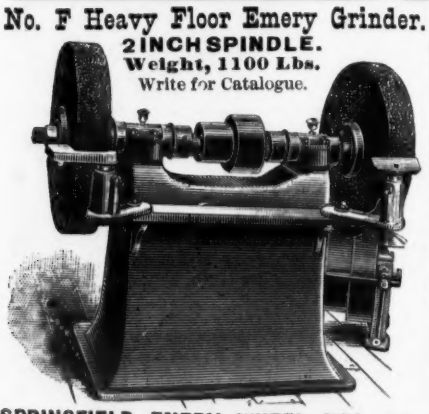

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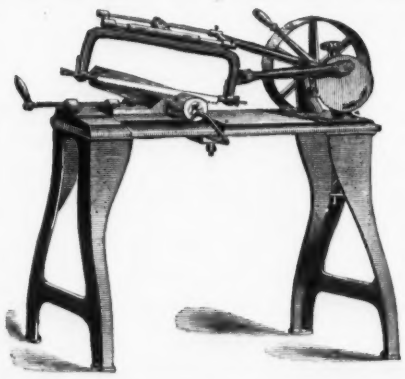

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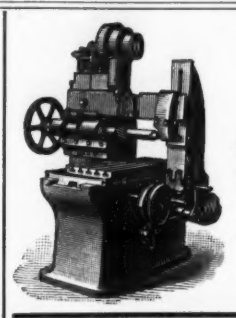

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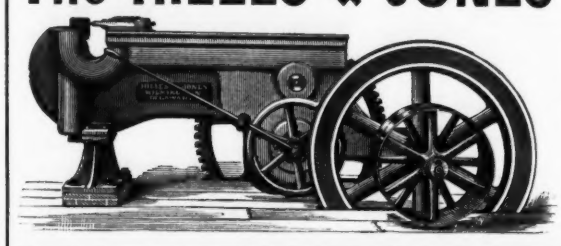

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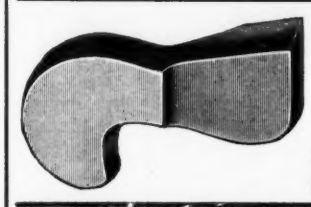

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Cutting from 1-8 in. to 6 in. diameter.
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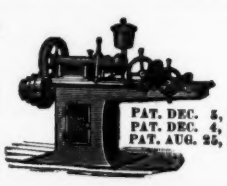

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GEAR CUTTING TO ORDER up to 60 in. Diameter.
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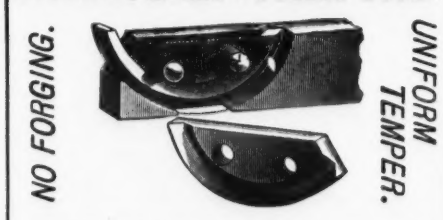

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CAN BE SECURED BY USING
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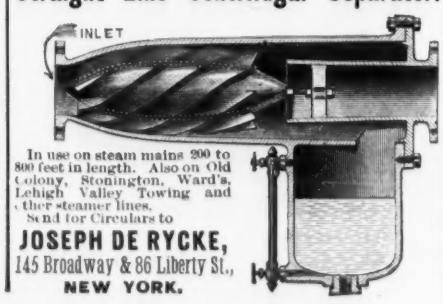

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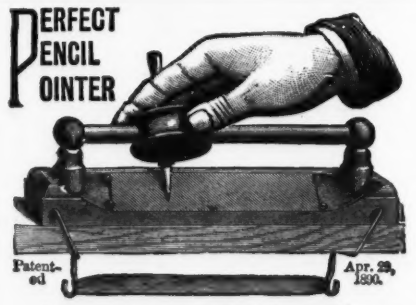

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Makes both a round and chisel point.
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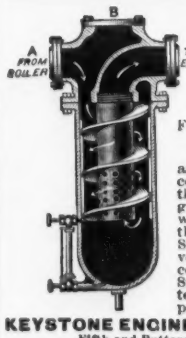

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For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.
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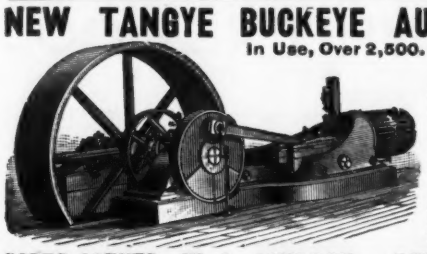
In Use, Over 2,500. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for Driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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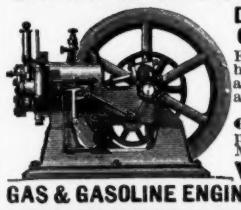

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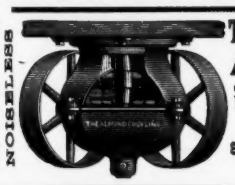

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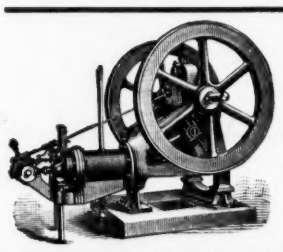

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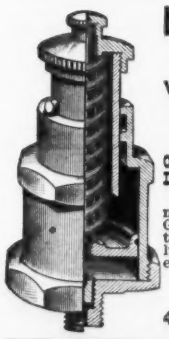

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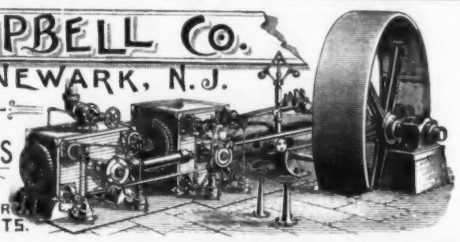

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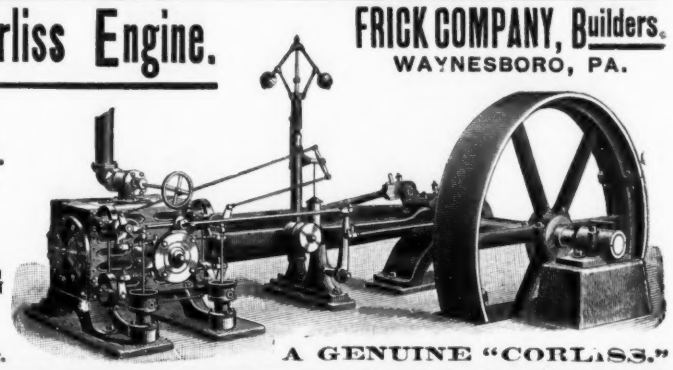

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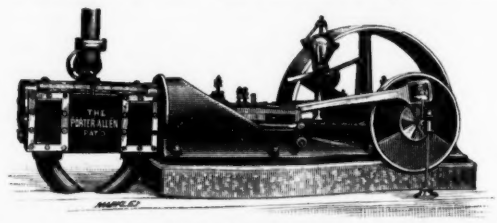

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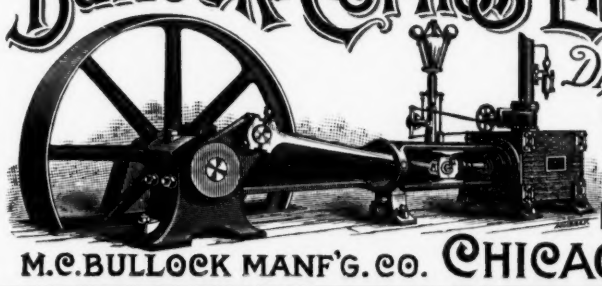

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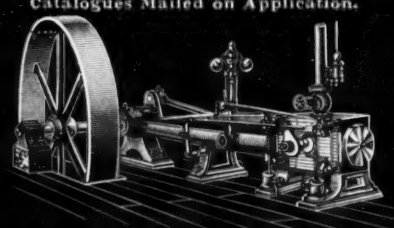

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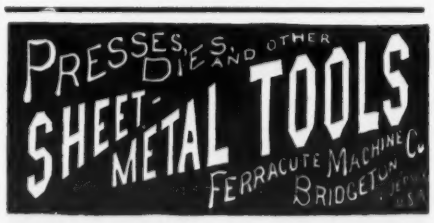

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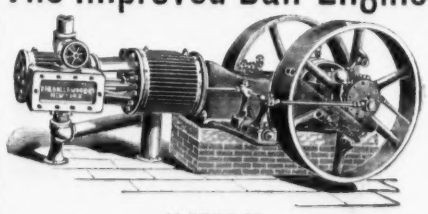

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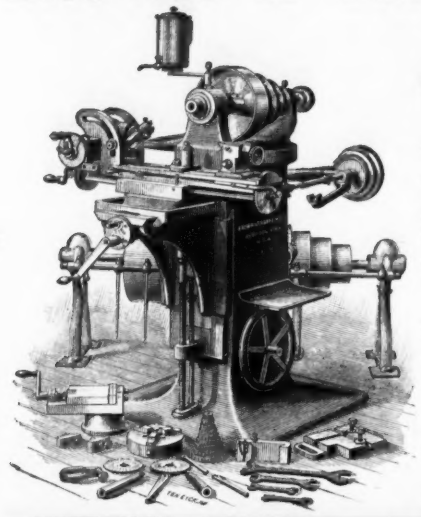

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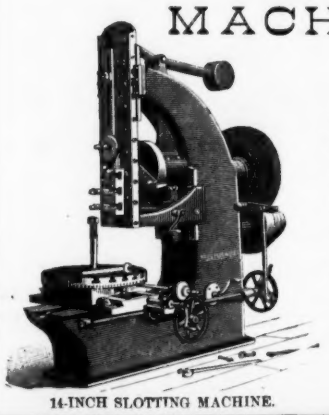

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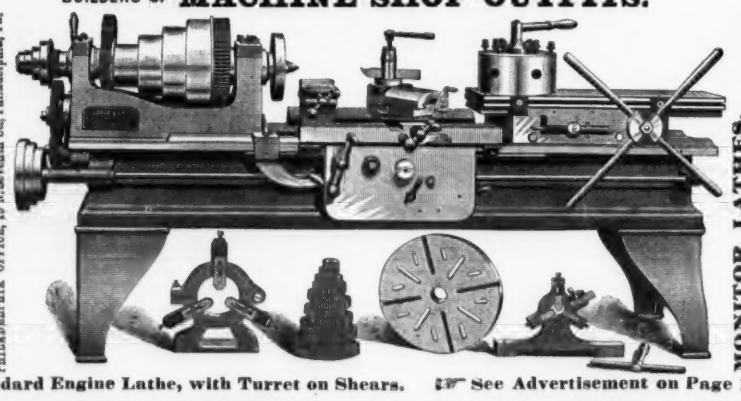

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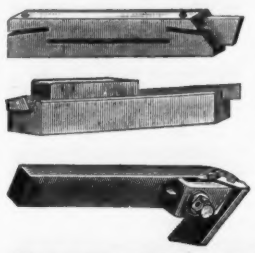

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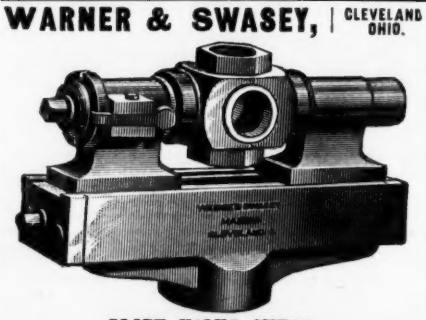

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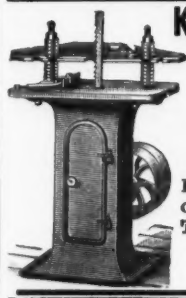

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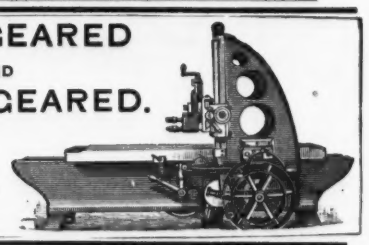

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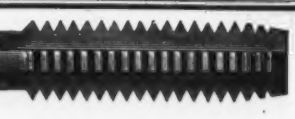

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